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A COMING TYPE OF BATTLESHIP.

An interpretation of the funnel-less ship with internal combustion engines as suggested by Mr. J. McKechnie, M.I.N.A.

WARSHIPS AND THEIR STORY

By

R. A. FLETCHER

Author of "Steam-Ships and Their Story"

WITH COLOURED FRONTISPIECE BY CHARLES DIXON, R.I.
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PREFACE

To the people of a seafaring nation the story of the growth of the warship, from the primitive craft of our savage ancestors to the marvellous fighting machines of the present day, should prove of endless fascination. In this book I have sought to indicate somewhat of the lines upon which the development of the world's warships has taken place. The amount of information available concerning warships is virtually inexhaustible, whether the ships are regarded structurally and comparisons are made of the forms of the hulls, the strains they may withstand, the speed of which they may permit, and their modes of propulsion; or whether, sociologically, as evidences of the stages of the progress of civilisation of the different peoples; or simply as aids to an appreciation of naval combat, of deeds afloat of individual and national heroism, of the rise and decline of maritime powers, and finally as implements in that tremendous struggle, which has made England what she is, for maritime supremacy. I have not written this book from any one of these aspects, but to describe in popular, not technical, language the more important types of warships favoured at different times in different parts of the world, to show, where possible, where type has succeeded type, and the main lines of divergence and development.

Reversing the usual practice of treating the warships as incidental to the naval battles, I have preferred to treat the naval battles as incidental to the warships. For that reason

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I have attempted no word pictures of the onset of contending fleets, no more or less imaginary accounts of famous engagements, no descriptions of weird manœuvres and impossible strategy. Even under the restrictions I have been compelled to observe, the abundance of material to be dealt with is so vast that I feel I have done no more than skim the surface, as it were, and have by no means collected all the cream. The task of deciding what to insert and what to omit has been no light one. Much that my readers and critics may think ought to have been included has, perforce, had to be left out, and the necessity of keeping the book within the limits of its present dimensions must be my excuse for the sins of omission of which I shall no doubt be found guilty.

So uneven, or erratic, has been the progress of warship construction, that in some of the world's harbours, riding the waters almost side by side, one may see dug-outs and "Dreadnoughts," sampans and submarines, canoes and cruisers, barges and battleships, the vessels of peace—though in times past they were not always vessels of peace—resting securely under the protection of the grim and terrible modern warships.

Every care has been taken to obtain accuracy, but I do not guarantee the absolute correctness of every detail given, for the simple reason that the authorities consulted are not themselves always in agreement, and this applies equally to the warships of the past as to those of the present time.

Every care, also, has been observed to give credit to other writers for the assistance derived from their books, and in this connection I would specially mention the "Encyclopædia Britannica," Mr. Cecil Torr's "Ancient Ships," Sir W. Laird Clowes' "History of the British Navy," Mr. H. W. Wilson's "Ironclads in Action," "The Warships of Europe" by Chief

Engineer J. W. King, U.S.A., "The New American Navy" by John D. Long, ex-Secretary of the Navy, U.S.A., "Maori Art" by A. Hamilton, "The New Zealanders" by George F. Angas, "History of Steam Navigation" by John Kennedy, "The Story of the Submarine" by Colonel C. Field, "Ancient and Modern Ships" by Sir George C. V. Holmes, "Submarines and Submersibles" by E. C. Given, M.Inst.C.E., "Canoes of the Solomon Islands" by C. M. Woodford, F.R.G.S., "Naval Architecture" by J. Fincham, "Rise and Progress of the Royal Navy" by Chas. Derrick, "Transactions of the Institution of Naval Architects," Appleton's Cyclopædia of American Biography, "History of the Marine Architecture of All Nations" by J. Charnock, "Our Ironclad Ships" by Sir E. J. Reed, "Cyclopedia of Antiquities" by Rev. F. D. Fosbroke, M.A., and the "Naval," "Navy League," and "Fleet" Annuals. A great deal of information has also been derived from the columns of *Engineering*, the *Engineer*, the *Times*, *Illustrated London News*, *Marine Engineer*, *Scientific American*, and other papers, to all of which I express my deep indebtedness. If it should be found that I have not acknowledged every item derived from these sources, I trust that this general admission will cover my shortcomings in this respect.

I have also to thank personally the Chief Librarian of the Colonial Office for assistance in dealing with some of the canoes; various officials of the British Museum for valuable suggestions they were kind enough to offer; Mr. A. J. Dudgeon, M.Inst.N.A. and M.I.M.E., for his kindness in again lending me his scrap-books; Mr. James A. Smith, M.Inst.N.A., for revising a portion of the proofs; the Secretaries of the Institution of Naval Architects and of the Institute of Marine Engineers for again placing the libraries

of those organisations at my disposal; the Secretary of the Navy at Washington for illustrations of vessels which achieved fame at the time of the American Civil War; the Commissioners in this country of the Imperial Japanese Navy for pictures of the early Japanese warships; the Hon. J. G. Jenkins, formerly Agent-General in London for South Australia, for New Guinea illustrations; Mr. Harry J. Palmer, of Paterson, N.J., for information and assistance in regard to American ships; and many shipbuilders, both in this country and abroad, for supplying details and illustrations of the vessels they have constructed. I have also to thank Lord Dundonald for his courtesy in lending me a picture of the *Rising Star*, probably the first steam war vessel to be built in this country, which his ancestor, the famous Admiral Cochrane, commanded in the service of Chili.

On other pages will be found a list of the illustrations and the sources whence they have been derived or the names of the gentlemen who have been kind enough to supply them.

R. A. Fletcher.

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INTRODUCTION

When or where the first warship was built is unknown, so also is the campaign in which it was employed. A war with naval usages of any sort cannot have been fought until the aggressor had some means of transporting the spoil across the water. From the raft to the fire-hollowed canoe was but a step, and having accomplished so much, the ingenuity of the naval architects of the period found scope in making improvements, gropingly, slowly, but none the less surely. The development of ships used for warlike purposes, as well as of ships designed as implements for fighting, forms a most attractive branch of study in its relation to the evolution of empires, no less than that of civilisation. Nor is the interest any the less if the attention be confined simply to the consideration of the development of the ships as ships of war.

In this book I am endeavouring to describe, clearly and briefly, the main features of the progress in warship building among the different peoples of the world, from the earliest recorded times onward. The greater attention is paid to modern warships, and the story of their development is narrated with an avoidance of abstruse technicalities, so that any reader of average intelligence and education may be able to obtain a clear understanding of the steps by which that wonderful creation, the modern navy, and especially the British Navy, has come into being.

Whether my readers belong to the bluest of the "blue

water" school; whether they advocate two British keels to one possessed by any possible combination of foreign powers as the irreducible minimum below which the British fleet shall not go; whether they take a more moderate view, founded, as they believe, on the power of the nation to pay for its fleet, and the ability of other nations to pay for their fleets, in which case the ability of some other nations to borrow money to have their best vessels built in British yards must not be lost sight of; or whether my readers belong to the other extreme and believe that any and every British fleet is too powerful and that the time is coming when the Imperial cheek shall be turned to the envious smiter: whatever be their political and social faiths, the fact remains that the fleet in being is the sole guarantee of this nation's safety, and that the payments for the several warships and the personnel of the Navy are but so many premiums for insuring the defence of the country and the maintenance of the inviolate integrity of these islands. Whether the money has always been spent to the best advantage is a point upon which experts differ, and is outside my intention to consider. But I hope to show something of the types of vessels provided, and, incidentally, to indicate how engineering skill and profound science have been devoted to the evolution of the modern ship of war.

The earliest known employment of a warship dates back, according to the present computations of Egyptologists, some six thousand years B.C.; but discoveries yet to be made may cause that estimate to be revised, for the more the scientific investigation of ancient Egypt is pursued, the greater is the tendency to date events more remotely still. All that is known of this ship is that it existed, and that it saw service as escort to a trading expedition on the Nile.

The first naval engagement of which we have any definite knowledge was fought near the mouth of the Nile about 1000 B.C. The ships held only a few men each and were propelled by rowers, and so little dependence was placed on their sails that the latter were furled to be out of the way during the actual fighting.

For hundreds of years oars were the chief means of propulsion, the sails only being availed of when the wind was very favourable. To increase the speed of the vessels, bank after bank of oars was added until ships carrying as many as eighteen banks are averred to have been constructed—though the evidence of the correctness of the statement is a long way from being conclusive—and one historian even goes to the length of asserting that a ship having forty banks of oars was built, but this may be disbelieved. For the most part, ships having two, three, or four banks were preferred for war purposes, because of their handiness.

Greater ships were afterwards built and improvements made in the shape and size of the sails and spars used, and the number of masts was increased.

Meanwhile in the Far North a seafaring nation was proving its worth. The wild men of the wilder North, the Danes, the Scandinavian Vikings—turbulent, adventurous and fierce, to whom fear was a word unknown—animated by the virile yet mystic mythology of the North, and inspired by the love of conquest and travel, now began to play their part in the world's naval history. The Vikings produced the "long ship," the "serpent," daring in conception, marvellous in construction, possessing wonderful qualities as a sea-boat, fast under sail or oar, and of a beauty of outline and shape hardly to be excelled even now. Such were the vessels in which the Danes

invaded England, and by building vessels as good as those of the Danes, and some rather better, King Alfred repulsed the invaders and implanted in the English that "habit of the sea" they have never lost. But the lesson of the Norsemen was destined to lie dormant for many a long year. Although the Romans had introduced the "long ship" for war purposes —so-called because it was longer in proportion to its beam than the merchant ships—the Mediterranean shipbuilders preferred as a whole to retain the heavy hull, and the form they believed best suited to their needs upon the tideless sea. Slave power was cheap, and was to be had for the trouble of capturing, and for many centuries oar-driven galleys were preferred over any vessel dependent upon sails only, and were to be found in the Mediterranean as late as the beginning of the nineteenth century.

As ships of greater size were provided in the Middle Ages, huge erections in the shape of castles were added at the bow and stern : great, unwieldy craft which contemporary historians likened to floating islands. The Venetian and Genoese republics elevated the art of constructing oared galleasses to its highest, and ere long Spain took the lead in producing warships with dimensions and power of armament which made her the chief maritime power of the world.

In England, owing to alternate periods of stimulation and neglect by the authorities, the progress of shipbuilding was spasmodic. The roughness of the waters round our coasts, and along the Atlantic coasts of France, the Low Countries and North Western Europe, caused greater dependence to be placed in small vessels having good sea-going qualities and using sail whenever possible. The *Great Harry* was begun in the reign of Henry VII. and finished in the reign of his uxorious

successor, and is interesting as indicating that shipbuilders in England were even then able to turn out a sea-going vessel superior to anything afloat. Henry VIII. established royal shipbuilding yards at Woolwich and Deptford, and thus founded the modern navy, but few warships for the King's service were built there in his time, and during his reign and for many a long year after it was the custom to hire merchant vessels and arm them—if they were not already armed to protect themselves against pirates—to augment the national fleet. Religious, no less than national, rivalry contributed, albeit unconsciously, to the development of the efficacy of the warship as a fighting unit. The enmity between Britain and Spain culminated, in Elizabeth's reign, after a series of daring attacks by reckless Englishmen upon the Spanish fleet in preparation for the great attack upon England, in the dispatch of the Armada. Hawkins and one or two others foresaw that the advantage would lie with the fleet which could be most effectively manœuvred. The disparity between the Armada and the British fleet was not so great as many writers have represented, either in the size or number of the vessels; but the British vessels on the average were smaller, faster, and better handled; in other words, efficiency told against sheer weight of numbers. This was the last great sea-fight on the ocean in which oared ships took part; they were no match for their smaller and more speedy sailing antagonists.

Structurally, most of the vessels of this time, the larger especially, were disfigured by high sterncastles, but early in the seventeenth century this encumbrance and many others had disappeared. Thence to the nineteenth century the development of warships was marked mainly by continual increases in their size, improving their form of hull and, consequently, their speed and buoyancy; augmenting their sail

area and perfecting the square-rigged system; and adding to the number of gun decks and the number of guns carried; until the grand wooden three-deckers swept the seas in all their ponderous pride and majesty. Ships of the line of various ratings played their part, and were ably seconded by frigates, brigs, cutters, sloops and bomb-ketches. All these were in vogue less than a century ago, and though not forgotten, are looked upon as historical and romantic and interesting curiosities.

In the weapons, no less than in the ships, the changes have been marvellous. For many centuries after ships were adopted for war, the fighting was done by soldiers carried aboard them. The human machines, the rowers, had to attend exclusively to their oars, for on them the safety or success of the fighting men depended. The main idea was to get to close quarters and fight hand to hand with javelin or sword, spear or battleaxe; bows and arrows were used when possible, and missiles hurled by hand were not despised. The ram, in various forms, affixed to the bows in such a manner as to strike the enemy's ship below or above the water-line, or both, was used with fearful effect in many a stubbornly fought engagement.

The introduction of artillery in the fourteenth century marked the beginning of the first great revolution in naval warfare, and the changes in the projectiles have been no less extraordinary than those in the guns.

The next great revolution was the introduction of the steam-engine. Its adoption in the British Navy in 1832 marked the beginning of the end of the sailing warship. Her last grim battle against inexorable fate was fought with the same doggedness which had distinguished her in many an

encounter with her nation's enemies; but the superiority of steam over sail was recognised. Temporising measures, a patched-up peace, as it were, lasted for a few years while the steam engine was employed as an auxiliary. Sail power, however, had reached its apotheosis so far as warships were concerned. Engineers, animated by practical common sense and ignoring romantic associations, improved their engines, so that the steam power was no longer the assistant of sail, but its associate, and was quick in attaining the position of chief partner and showing that sails could be dispensed with altogether. The Crimean War sounded the knell of the wooden battleship as well as of the paddle-wheel war steamer. The former gave place to the iron-clad vessel, and the latter was supplanted by the screw-propelled ship. The power of artillery had shared in the application of scientific knowledge and benefited accordingly. The great battle between the maker of armour plates and the maker of guns and projectiles had begun. Iron, the conqueror of wood, had but a short reign. Where iron was used a few years ago, steel is now invariably employed. The thoroughness of the victory is shown by the fact that in the whole of the British Isles not one iron vessel, large or small, was built in 1909 for war or commerce.

The years 1905 and 1906 saw two of the most important steps forward in the history of warships, for they included the adoption of the turbine principle of warship propulsion and the "Dreadnought" principle of armament. The progress of the last fifty years, culminating in the *Dreadnoughts*, has been wonderful; already designs of vessels intended to relegate them to second place are under consideration.

Type after type of battleship, cruiser, scout, gunboat, destroyer and torpedo-boat has followed in rapid succession

of late years, and submarines have become an accomplished fact. He would be a foolish man who would prophesy that the end is in sight.

There is nothing more marvellous in the world's history than the tremendous development in marine engineering, in warship construction, in explosives, in armament, and in projectiles that has taken place in the latter half of the nineteenth century, and especially in the last twenty-five years.

WARSHIPS AND THEIR STORY

CHAPTER I

FROM ANCIENT EGYPT TO THE INTRODUCTION OF ARTILLERY

When did man first entrust himself afloat for purposes of war? and what was the type of vessel he employed? are questions which take us back almost to the earliest stages of historical human progress, concerning which all the knowledge of the antiquaries is but conjectural, a stage so remote that scientists have not yet determined how many thousands of years ago it existed. The earliest vessels thus employed must have been transports, and nothing else; but if employed as aids to aggression when the kings of the earth took counsel together and, impelled by avarice or a desire to assist in one another's turbulent love affairs, or, for their own safety, convinced of the necessity of finding an outlet for the energies of their restless subjects, invaded the territories of their neighbours, the ships, whatever their nature, will have been of a size sufficient to receive any spoil or any prisoners worth the trouble of carrying back again.

So far, however, as research has disclosed in those parts of the Near East where civilisation was cradled, there is no indication that man fought afloat—boat against boat, or fleet against fleet—until after a comparatively high stage of civilisation had been attained and shipbuilding had made enormous advances.

Evelyn remarks: "Concerning men of war, fleets, and

armadas for battel, that Minos was reported to be the author, which shows that manner of desperate combat on the waters to be neer as antient as men themselves, since the deluge." Minos, he adds, disputed the empire of the seas with Neptune, but "these particulars may be uncertain."*

Among the legendary expeditions, those of Ulysses and Jason are the best known. Possibly they took place, but the adventurers never did or saw half the wonders narrated of them. Herodotus, describing the type of ship attributed to Ulysses by Homer, states that such ships were made of acacia, of "planks about two cubits in length," joined together like bricks, and built in the following manner: "They fasten the planks round stout and long ties: when they have thus built the hulls they lay benches across them. They make no use of ribs, but caulk the seams inside with byblus. They make only one rudder, and that is driven through the keel. They use a mast of acacia and sails of byblus. These vessels are unable to sail up the stream, but are towed from the shore."† Book II. of the *Iliad* mentions, in the famous catalogue, hollow ships, well-benched ships, swift ships, and dark ships, and that Ulysses had twelve red ships, but Homer, being a poet and a landsman, did not describe their differences.

Recent excavations and discoveries in Egypt have revealed the existence of boats of considerable size, so remote in history that their period is only guessed at, though they are estimated to date from about 5000 to 6000 years B.C. If the interpretation of the designs on the pottery recording these old ships be correct, they were propelled by over a hundred oars or paddles, were steered by three paddles at the stern, and had two cabins amidships. They were, moreover, very high

* Evelyn's Memoirs. † Bohn's Library.

out of the water at the ends, having very long, overhanging bows and counters, and were shallow and flat-bottomed.

Even at this period the art of shipbuilding was in a comparatively advanced stage; vessels such as those depicted would be quite as capable of use in war for carrying warriors or stores, or both, as in commerce for conveying merchandise. Egypt has many historical secrets yet to reveal, and, judging by the constant reassignment of dates in all matters connected with Ancient Egypt which exploration has entailed, it is not too much to expect that the dates quoted, assigned approximately by Egyptologists, may be revised and events placed more remotely still.

Another hieroglyph, discovered in a tomb, ascribed to the year 4800 B.C., shows enormous progress in shipbuilding and also in the art of representing a ship pictorially.

During the Sixth Dynasty, a certain Un'e, who was a person of note under three kings, sent, while the second, Pepi I., was on the throne, an expedition to the quarries of Syene or Assouan, to fetch stone for his master's pyramid.

Another expedition, on behalf of Pepi's successor, merits attention, as the fact is emphasised on the inscription on the tomb as most remarkable, and as never having occurred before "under any king whatever," that Un'e had to employ twelve ships for freight and but one warship.* The flotilla consisted of "six broad vessels, three tow boats, three rafts, and one ship manned with warriors."†

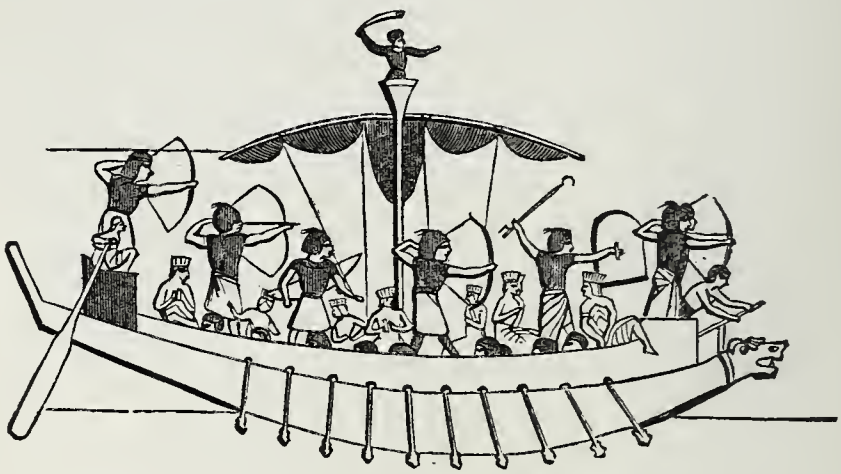
The Egyptians evidently had experience of some sort of fighting afloat, for there has been discovered at Gebel Abu Faida a tomb with a painting showing a boat with a triangular mast, and a stem extending forward below the surface of the

* "Life in Ancient Egypt," by Adolf Erman.

† "A History of Egypt under the Pharaohs," by Dr. H. Brugsch Bey.

water and presumably intended to be used to damage an enemy's boat by ramming it.*

The first sea-fight of which a pictorial representation is known to exist was fought off Migdol, at the mouth of the Nile, in the time of Rameses III., first king of the Twentieth Dynasty, which began about 1180 B.C., and lasted to about 1050 B.C. Egypt was invaded from the East by "warships and foot soldiers," and the Egyptian monarch mustered a fleet and attacked them.



ANCIENT EGYPTIAN WARSHIP.

"The ships on both sides," says the historian†—"we can recognise the Egyptian by the lion heads in the bows—have reefed their sails in order not to interfere with the men who are fighting; the bracket at the mast head has been removed to make room for the slinger. The Egyptians understood how to pull round the ships of the enemy with their grappling irons, so as to bring them to close quarters; in fighting also they have the better of their opponents, for they all carry bows, whilst the barbarians with their short swords can only fight

* "Nile Gleanings," by Villiers Stuart.

† "Life in Ancient Egypt," by Adolf Erman.

in a hand-to-hand medley. This battle is almost the only naval engagement in Egyptian history, for though in the wars with the Hyksos we certainly hear of fighting on the water, yet in the latter case the Nile was the scene of action. . . . The ships had their individual names, such as *Battle Animal*, or *Glorious in Memphis*. The *Ship of Pharaoh* was also called *Beloved of Amon*."

A remarkable difference between the ships of the Egyptians and those of the Asiatics is that the latter had no rowers, if the bas-relief is accurate. Possibly the Asiatics, Phœnicians probably, had discovered how to manage the sails of their warships and dispense with rowers.

The example set by the Asiatic fleet does not seem to have been followed, for as the need of greater ships became manifest the problem of their propulsion was met by placing one bank or tier of oarsmen above another. Then, as now, the propelling power was vital to the efficiency of the ship, and means had to be devised for the preservation, or at least protection, of the oarsmen. The single-banked ships had planks placed round the gunwales, forming a parodus, or gangway, which served also to guard the rowers from missiles. Later, the upper tier was in an open superstructure, and still later, planks were carried which could be adjusted for the protection of the oarsmen when necessary.

The ram, employed by the Egyptians—who seem to have retained for their sea-going craft the long, overhanging stem and stern so suitable to their river vessels—was a metal head, which added a finishing touch to the projecting bows, and was high above the sea level. At the time of the battle of Migdol, and possibly also of the sea-fights in the reign of the preceding Rameses, who is known to have conducted a naval war, though of this campaign no illustrations have yet been discovered,

the captain of the warship was placed in a sort of crow's nest on top of the double or Λ-shaped mast.

Then comes a long gap in the history of Egyptian shipping. The Phœnicians became the leading maritime people of the world, but the little that is known of them is derived, not from discoveries in their own cities of Tyre and Sidon, but from the records preserved at Nineveh. Sennacherib's conquest of Phœnicia was commemorated by mural tablets, on which are the only known records of Phœnician war galleys. The Phœnicians are stated to have invented biremes, or vessels carrying two banks of oars on each side. Perhaps for lightness, and in order to reduce the top weight as much as possible, these galleys had the upper bank of oarsmen unprotected. The prow, differing from that of the earlier Egyptian ships, curved forward at a point slightly above the water line, and continued to do so under the water, thus forming a formidable snout or ram which could inflict considerable damage to the most vulnerable parts. The beaks were generally carved to represent the head of some animal. The vessels also had a parodus placed outside the vessel and extending the whole length of the sides above the oars. The contrivance was probably copied from the Egyptians, who introduced it to enable the warriors to fight at close quarters when drawing alongside an enemy, or to run to either end of the ship as occasion might require without impeding, or being impeded by, the rowers.

Cancelli, or shields of basket work, were placed along the sides of the ships at such a height that the heads of those on board are just visible. The *cancelli* bore a striking resemblance to the circular basket-work boats still to be found on the upper Euphrates; this supports the supposition that the *cancelli* may have been used for other purposes, particularly if they

GREEK BIREME.

From a Vase in the British Museum, found at Vulci.

GREEK WAR GALLEYS.

From a Vase in the British Museum found at Vulci.

were made comparatively watertight, as the function of a shield was not only to protect a warrior in battle, but to help to keep him dry when on shipboard by being disposed along the sides to prevent the spray from entering the ships. A forecastle was constructed upon these ships, and upon each forecastle a look-out man was stationed; and when these structures came to be built of larger dimensions they served to accommodate a number of fighting men who, from their superior position, could throw their missiles with greater effect. The forecastle had the further advantage of serving as a stronghold in the event of an attempt being made to capture the ship by boarding it.

Following the Phœnicians, the Greeks are thought to have begun to build their own warships about 700 B.C., perhaps earlier, but it was about that time that the first three-banked warship was launched at Corinth. The three-banked ships were for many years the largest in existence. During the fourth century B.C. shipbuilding was practised extensively, four-banked ships being built at Chalcedon, five-banked at Salamis, and six-banked ships at Syracuse. Ships of ten banks, according to Pliny, were ordered by Alexander the Great, and about 300 B.C. ships having twelve banks are said to have been built for Ptolemy, and fifteen-banked ships for Demetrios, for a battle near Cyprus.

Ptolemy Philopater, who ruled in Egypt from 222 to 204 B.C., is alleged to have had a forty-banked ship of a length of 280 cubits or, reckoning the cubit at 18 inches, of 420 feet, and a beam of 57 feet.

While increasing the size and number of oars, it would, nevertheless, be impossible to augment to any appreciable extent the speed at which these ships could be rowed, and the more unwieldy would they become, and the more difficult

would it be to keep steering way upon them. Again, the assertions of the historians are so contradictory that it is a thankless task to attempt to reconcile all their stories, especially as they depended much upon hearsay for their information. For that reason, therefore, a great deal that has been recorded as to the early ships and their numerous banks of oars is not to be accepted without careful inquiry and verification.

It has never been established beyond question what is meant by banks of oars, or whether the Greek text has been interpreted correctly when it is taken to express forty superimposed banks of oars. From constructional reasons it may be assumed that a ship having forty superimposed banks of oars never existed, and it is very doubtful whether ships having more than a fourth of that number of banks passed beyond the imaginations of their inventors. In any case they were soon dispensed with, and in course of time it was found that the best results were obtained with galleys having two or three banks of oars.

It is not definitely known how the rowers were disposed in the ships of anything over seven or eight banks. If any vessels had forty banks of oars, the upper rows must have been of an absolutely unwieldy length. Assuming the oars to have been weighted with lead so that the inborne and outborne portions were equally balanced, they must nevertheless have been exceedingly difficult to row even by a number of men, and it was impossible for any rowers to have moved these great oars at the same speed as the men at the lower banks moved their lighter and shorter ones. That some such difficulty was experienced, even in biremes and triremes, is shown by the arrangement of the oars, whereby all in a bank were not of equal length, but were graded so that those nearer the ends of the banks were longer in order

that all the blades might enter the water in a straight line. Each row above must have had its own line in the water a little farther away from the side of the ship than the row beneath it, or the blades would have interfered with each other and the rowers thrown into hopeless confusion. The tremendous amount of lead that would have to be carried to counterbalance the outborne portions of several hundred oars would add materially to the dead weight to be propelled, and, much of it being placed high above the water, the stability of the vessel would be lessened.

The Athenians used leather or skin aprons or covers over the oar holes to prevent the water entering, the oar passing through a hole in the leather, and the apron was bound to the oar in such a way as to be watertight. This contrivance was widely adopted later. The oar ports were constructed between the ribs, but the oars instead of being rowed against the ribs were pulled against thongs fastened to the next rib, thus minimising the strain upon the ship's structure and preventing the oars being lost overboard. One man one oar was apparently the general rule at that time.

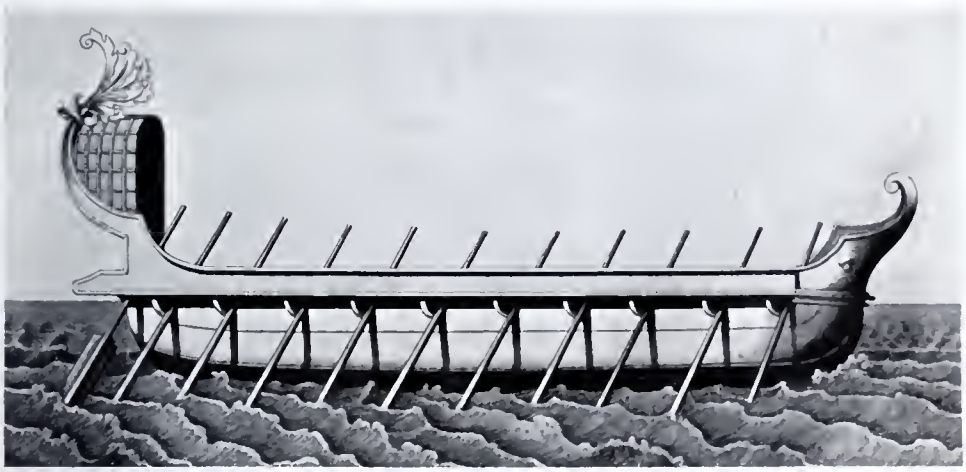
In his most painstaking study of "Ancient Ships" Mr. Cecil Torr has gone very closely into the subject of the oar equipment of the galleys. An Athenian three-banked ship would carry two hundred oars, of which thirty were worked from the upper decking, sixty-two on the upper bank, and fifty-four to each of the lower. The earliest two-banked ships had eighteen rowers. An Athenian four-banked ship might carry two hundred and sixty-six oars. The Roman and Carthaginian five-banked ships in use about 256 B.C. had three hundred rowers besides the combatants. The statement is made by an early historian that in 280 B.C. the Heraclean fleet on the Black Sea included an eight-banked ship with a hundred rowers

on each file, or one thousand six hundred rowers in all. As usually the fighting men carried exceeded the rowers in number, the ship must have had close upon three thousand five hundred men aboard.

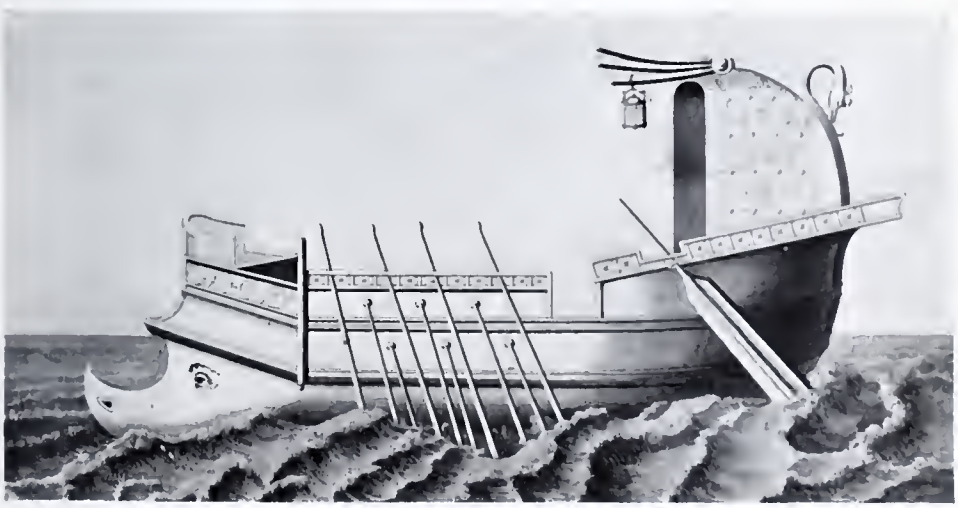
Warships of all the early Eastern nations were strengthened by cables passed longitudinally round them in order to keep the timbers in place and prevent them from being started under the strain occasioned by the shock of ramming. Egyptian ships of about 1200 B.C. had cables stretched from stem to stern and passing over the top of the mast and other posts, but this contrivance was to prevent the vessel from drooping at the ends, a weakness known as "hogging." The shock to the ramming vessel was scarcely less severe than that to the vessel receiving the blow. To take up the strain and add to the power of the blow the bows were strengthened by means of waling pieces which supported the ram proper. The Greek ships were built with the keel, the stempost, and the lower pair of waling pieces converging to hold the ram, while higher up the stem was a smaller ram which in its turn was buttressed by another pair of waling planks. The catheads, or beams projecting from the bows on either side by which the anchors were raised, were so placed on a level with the gangway and gunwale that they would sweep the upper works of an enemy's ship and smash its gangway and hurl into the sea or the hold all the fighting men upon it. Ships of more than three banks are believed to have carried another ram level with the catheads, and to have had a ram for every pair of additional waling beams. The ram heads were generally of bronze and weighed 170 lb. or more.

The later rams varied considerably in shape. The triple ram was sometimes made with the teeth pointing slightly downward, while others had an upward tilt. The lowest ram

"AN ANCIENT BIREME, FROM BASIUS, HAVING ONE TIER OF OARS ONLY."



"ONE OF THE ANCIENT LIBURNI, OR GALLEYS, HAVING A SINGLE TIER OF OARS, ACCORDING TO BASIUS."



AN ANCIENT TRIREME, ACCORDING TO BASIUS.

From Charnock's "History of the Marine Architecture of all Nations."

often extended farther forward than those above, the idea being that it would inflict severe injury about or below the water line, and that the upper rams, besides causing damage, would push the stricken vessel off the lower ram and let her sink without the assailant being dragged down by the head with her.

The build of the ships rendered it necessary that an engagement should be fought on a calm sea, and daylight was preferred in order that the combatants could see what they were doing. As the fleets approached one another the commanders of the different vessels decided upon their individual opponents. Much skilful manœuvring ensued to ram the enemy or avoid a blow. The slaves strained at the oars while their taskmasters ran between the files of rowers and, with unmerciful blows from heavy sticks and whips, stimulated them to still greater exertions if possible.

Poor slaves, mostly prisoners of war, their prospects were gloomy in the extreme! If their ship were rammed some of them were sure to be injured, and if she sank they went down with her, fastened to their places and having no chance of escape. If the oars were disabled in the collision between the ships the rowers were bound to receive violent blows from the inboard end of the oars, or to be cruelly pierced by splinters of wreckage. Showers of missiles from the opposing ship fell upon the helpless wretches. In later years, when the terrible Greek fire was added to the means of attack and defence, it contributed the prospect of being burnt alive to the other horrors of their situation. Victory meant no rejoicings for them. The wounded were of little account and could be dispensed with when slaves were to be had for the capturing, and it was easy to put them overboard to die the more quickly. Those who survived the battle unhurt

or not too severely injured to recover rapidly, were retained. If their ship were vanquished they might look forward to greater cruelties as a punishment for their share of the defeat. If they belonged to the victors, they had only more battles, the torturing whips of their drivers, and insufficient food as their portion in life. Death came as a welcome relief to the slaves of victor and vanquished; in it lay their only hope of peace.

When the Roman navy was at its best the ships were painted a colour which matched the waves, and the hulls were made as watertight as possible with tar. Occasionally in the later Roman ships layers of tarred cloth were placed outside the outer planking, and the hull was then lead-sheathed. Bronze nails and wooden pegs were used in fastening the timbers together, and some ships were so built that they could be taken to pieces and transported overland if necessary. Ships of three, four and five banks were even conveyed from the Mediterranean to the Euphrates.

The facility with which the Liburnians handled the two-banked ships in their Adriatic campaign induced the Romans to adopt these vessels as models for their own two-banked ships, and in course of time they adopted the name of *liburna* for all war-vessels of from one to five banks.

If some of the historians may be believed, anything that could be piled upon the ancient ship and did not capsize it was permissible. One is said to have had a tower at the stern and another at the prow. Another bore "a large tower of masonry with a great gate. Here appear some vases, probably filled with combustibles." Another *libernus* has a mast or yard, suspended perpendicularly by the side of the forward tower, and having at each end a crossbeam. Yet another *libernus*, besides carrying a protector for the helm at the stern,

is said to have had six round towers ; the largest, of embattled masonry, was at the prow, two others, also of masonry, surmounted by domes, and connected by a bridge, were near the stern, and the other three were nearer the fore part of the ship, were roofed, and two of them had windows.

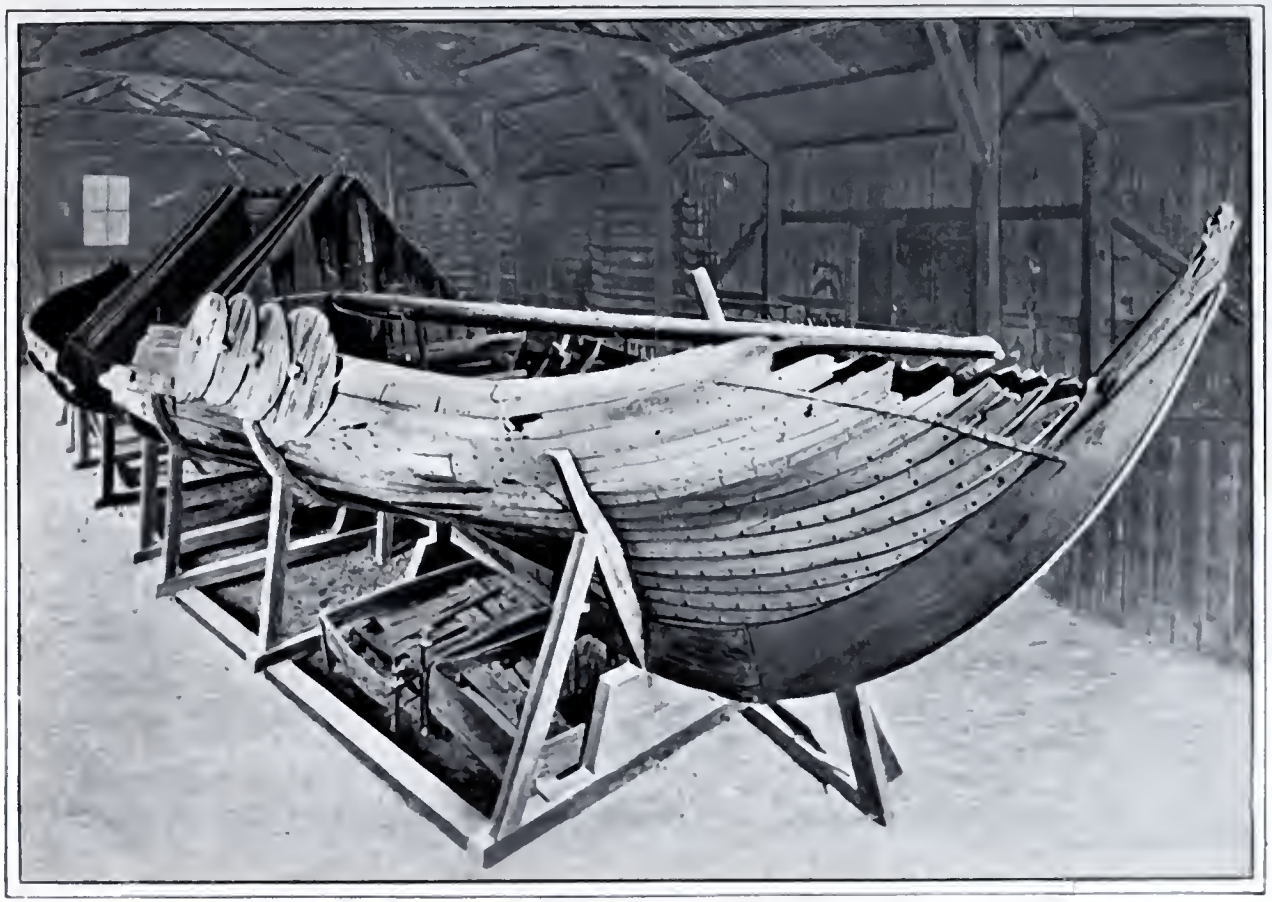
Shipping in the Mediterranean extended with extraordinary rapidity in the recovery after the stagnation caused by the fall of the Roman Empire and the relapse into semi-barbarism which followed the successful invasion of Italy by the wild tribesmen of the North. The advent and rise of the Moslem power caused a series of struggles in which every state was in a more or less constant condition of warfare against its neighbour, and the Crusades served but to add fuel to the fire of internecine and religious conflict. Some immense ships are stated to have been employed up to and at the fall of Constantinople. The early centuries of the Christian era saw the evolution of a flat, shallow vessel, fitted with one or two masts carrying sails, from which the lateen rig developed, equipped with a long ram above the water line, with two or at most three banks of oars. It appears from illustrations that some of these boats carried a superstructure extending beyond the beam on either side. War vessels of this type became common throughout the length and breadth of the Mediterranean, and remained in use long after the introduction of firearms.

Before the discovery of Greek fire, flaring missiles of some kind had been devised. Frontinus mentions fire-ships, or hulls carrying combustibles and allowed to drift with wind and tide upon the enemy's ships : stinkpots, to nauseate the enemy, though how the others escaped the smells except by keeping to windward does not appear ; and Evelyn adds, "Nay, snake pots, and false colours." The Greek fire, how-

ever, was the most terrible of the weapons employed at that time. By some means by which a fair amount of power was exerted, the liquid was squirted—or vomited, to use one historian's phrase—through copper pipes upon an enemy's ship, and as the liquid had the peculiar property of igniting upon exposure to the air and was inextinguishable by water, it was a most formidable engine of destruction. Small vases filled with the liquid and sealed airtight were used as hand grenades and flung at opposing ships and, breaking, set them on fire. Heavy arrows carrying balls of flax soaked in the liquid were used both in land and sea warfare, as also were hand-flung javelins similarly equipped, and the flights of these masses of inextinguishable flames must have been equally demoralising to the combatants against whom they were directed and destructive to the ships and inflammable buildings upon which they fell. This composition is thought to have been invented in the seventh century; the first occasion on which it was employed on an extensive scale was in the great battle between the fleets of Constantine and the Saracens, when the latter, through its agency, lost practically their whole fleet and thirty thousand men killed. After that both sides used Greek fire whenever possible.

Up to the introduction of gunpowder and artillery the methods of fighting varied but little. The sea-fights of the Crusades were conducted on the lines which had been recognised as the best for a couple of thousand years or more, viz., ram the enemy and board him. Greek fire added this rule: Burn him also if you can.

The countries along the northern and southern shores of the Mediterranean had attained a high degree of civilisation when the inhabitants of Western Europe and the British Islands were still more or less savage. What may be regarded



VIKING SHIP FOUND AT GOKSTAD, SOUTH NORWAY.

Photograph: O. Vaering, Christiania

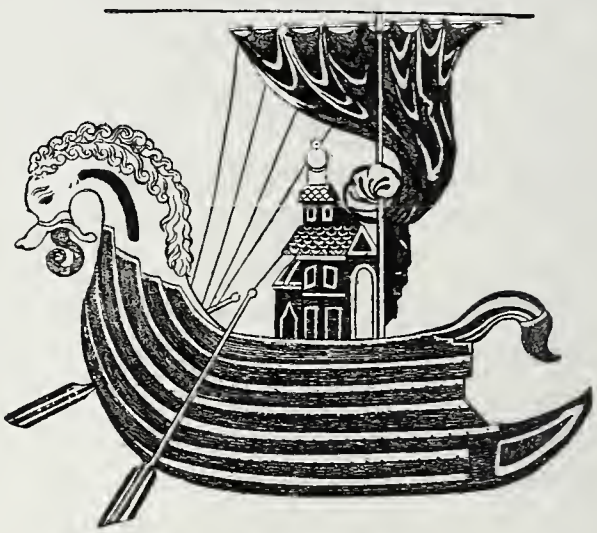
PENNSYLVANIA
STATE LIBRARY

as circumstantial evidence in support of the contention that the Phœnicians voyaged to Cornwall and Ireland is the similarity which exists in shape between the wicker shields, such as the Phœnicians are known to have used, and the wicker coracles which the Britons employed at the time of the invasion by Julius Cæsar. There must have been considerable intercourse between the Phœnicians and the dwellers in the valley of the Euphrates before the latter conquered the former; but whether the dwellers in Nineveh, or those by the sea, invented wicker boats, or whether both derived their knowledge of wicker boats from other sources, are points of no immediate importance. But what is of interest is that the British wicker coracles were covered with hides to make them watertight, that they had keels and gunwales, and that they were small enough to be used as shields if necessary, their dimensions being rather over 4 feet in length, with a breadth of about 3 feet, and a depth of a trifle over 12 inches. They were big enough to carry one man of average size. There are on the Euphrates to this day boats or rafts of proportionate dimensions, up to a maximum length of 40 or 50 feet over all, which are constructed with a light framework of wicker and timber, over which skins are stretched to keep them watertight. These boats, when laden, drift down the river with the current, and, on reaching their destination, their cargo and skins are sold and the framework is made up into a package and returned upon the back of an ass to the port of departure. These cargo boats have been humorously referred to at a meeting of the Institute of Marine Engineers as of "one ass-power."

So far as Britain is concerned, the shipping of each coast seems to have developed under the influence of the foreign shipping with which it mostly came in contact. The east coast was largely concerned with the Danes, and the south

coast with its neighbours across the Channel. The Danes and Vikings developed a type of vessel peculiarly their own. The best specimen yet brought to light is that known as the Gokstad ship.

The Viking ships must have walked the waters almost with the grace of motion of a modern yacht, and when the great square sail was hoisted, bearing the escutcheon of some



AN ANGLO-SAXON SHIP OF ABOUT THE NINTH CENTURY.
(From Strutt.)

dread sea-rover, they must have been fascinating emblems of human skill and power no less than of the noblest and the basest passions of mankind.

The large rowing and sailing galleys of the Mediterranean were fine-weather ships, it being the custom to suspend merchant voyages, naval expeditions, and piracy in that sea during the winter months. Obviously, such vessels were wholly unsuited to the Atlantic coasts of Western Europe. The western coasts of Spain, France and Portugal produced a ship, short and broad, and strong enough to be beached even

when a moderate sea was running. This model was seemingly copied by the English of the south coast, and vessels of this type, built in the eighth century, were planked and carried high, erect stemposts and sternposts. The vessels were single-masted and fitted with a yard and square sail, and the steering was effected by a large oar at the stern. They were not unlike the Viking ships in some respects, but they were of less average length and broader in proportion, having bluffer bows, a less fine entry, and a long flat floor extending farther aft than did that of the northern ships. Some also had a ram.

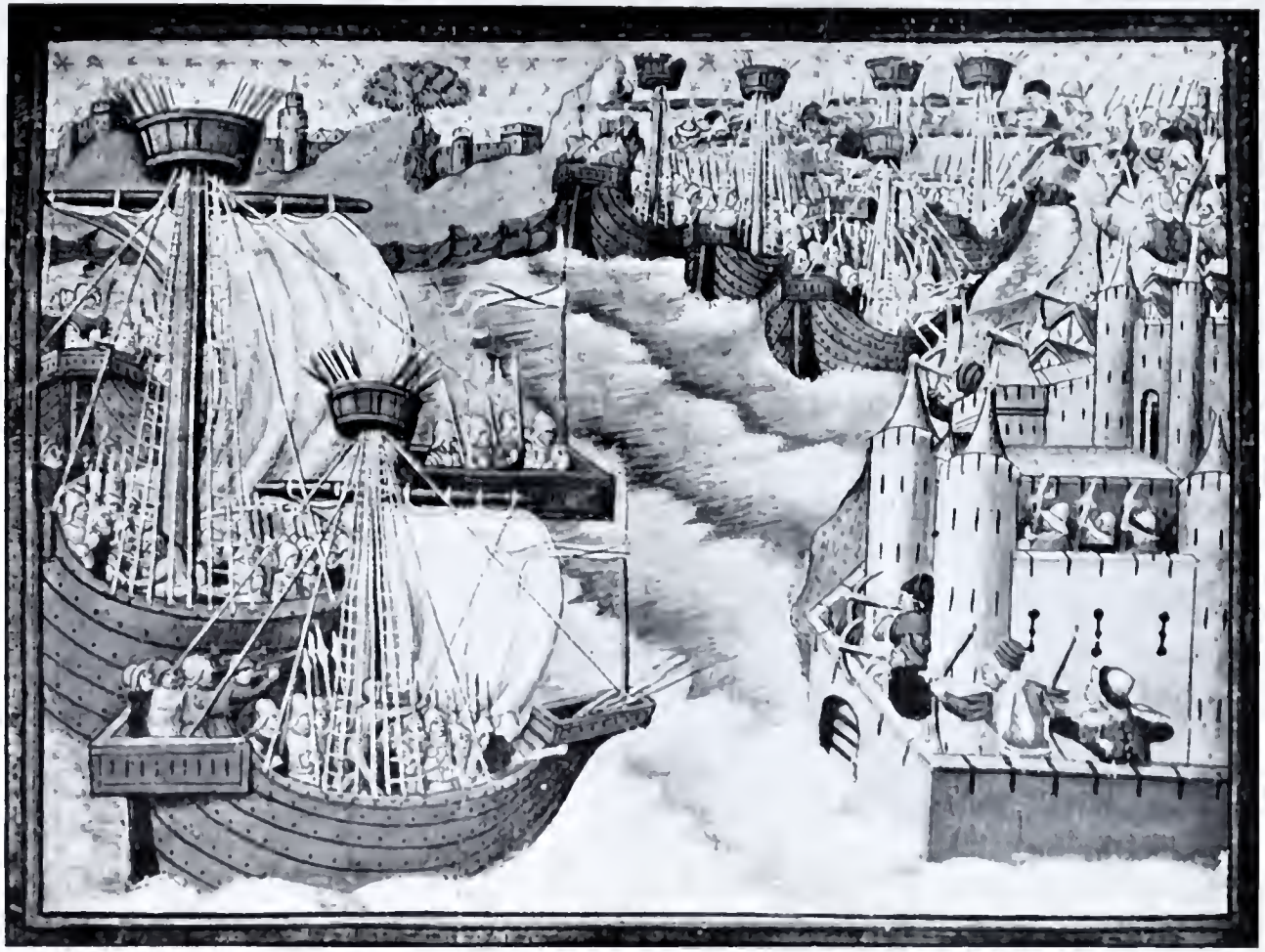
What may be regarded as the first great national step in British shipbuilding was inaugurated in the latter part of the ninth century, when King Alfred saw that in order to beat the Danes he must meet them with ships superior in size and strength to their own. His war galleys were virtually double the size of those of the invaders, and in some instances almost double their length. The Gokstad ship, by no means one of the largest of its type, had sixteen oars a side. If Alfred's boats had thirty oars or more a side, as is stated, and were double-banked—that is, two men to each oar—like those of his foes, the fighting strength of the individual ships of his navy must have been very great.

By the eleventh century the Norsemen had taken to painting their vessels externally, besides making them larger and giving them decks. The stempost and sternpost were more ornately decorated, gilded copper being the material used for this purpose. Svend Forkbeard's own ship, the *Great Dragon*, is said to have been in the form of this legendary beast, but what the historian most likely meant is that the stem decoration or the design on the sail may have shown a fantastic representation of the fearsome animal; the Vikings were too good

seamen to have built the ship in any form likely to be inferior to the shape they had learned to appreciate so highly. The *Long Serpent,* which appeared in that century, is said to have been 117 feet in length, and decked, and to have carried six hundred men. This is the first war vessel in the Western seas known to have been decked throughout,* and in which cabin accommodation was provided for the principal fighting men. Beneath the deck the hull was divided into five cabins or compartments; the foremost was the *lokit,* in which, in a royal vessel, the king's standard bearers were quartered; next, the *sax* or storeroom; then the *kraproom,* where sails and tackle were kept; the *foreroom,* containing the arms chest, and forming the living room of the warriors; and astern of all was the *lofting,* or great cabin, devoted to the commander. For the comfort of the rank and file of the fighting men at night in port an awning was spread, supported by a ridge pole on pillars. At other times they would seem to have had to put up with sleeping on deck and making the best of it; they would certainly be no worse off than in the old days of the open ships, and being somewhat higher above the water would be less exposed to the spray. At the end of the twelfth century King Sverre Sigurdsson had some merchant ships cut across amidships and lengthened, and then used them as war ships.

William the Conqueror's fleet in the eleventh century is estimated at anything between six hundred and ninety-six vessels and three thousand; a manuscript in the Bodleian Library gives the number as one thousand. Most of the vessels were small, if the illustrations on the Bayeux tapestry are to be accepted. The type of ship is no doubt represented

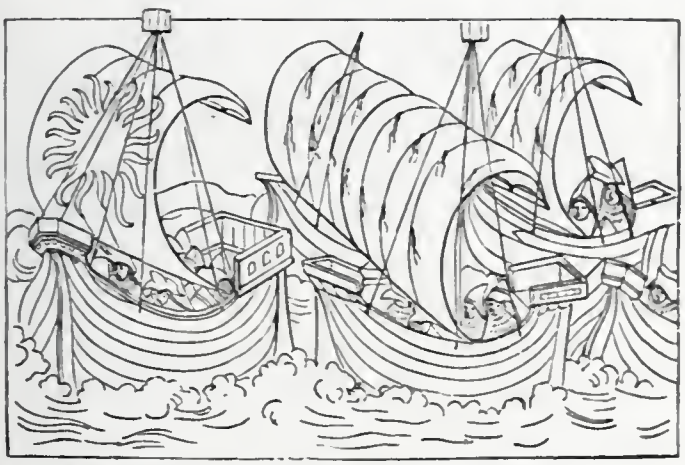
* Paper on the Viking ships, by Mr. N. Nicolaysen, President of the Christiania Antiquarian Society.



FLEET ATTACKING A FORTIFIED TOWN.

MS. Harl. 5

with a fair amount of aeeuraey, but in eertain other respeets the efforts of the weavers of the tapestry are only less grotesque than the so-ealled ships whieh appear on some of the medals of the ports, but whieh nevertheless have been aecepted as eorreet representations of the ships of the times, whereas they should be regarded as indieating approximately the type of vessel then in vogue. With the exeeption that a few ships were built of rather greater dimensions—the largest in the



WARSHIPS OF THE FOURTEENTH CENTURY.
(After Harleian MS.—1319, fol. 18.)

invading fleet can hardly have been more than 80 tons burthen —shipbuilding shows but little development on the Atlantie eoast until after the introduetion of artillery.

A battle between a Cinque Ports fleet under Hubert de Burgh and a Freneh fleet under Eustaee is ehiefly remarkable by reason of the English manœuvring to seeure the windward position, this being the first oeeasion on which this manœuvre is reeorded, and the attack on the Freneh rear ended in a signal English vietory. The fame of the English arehers was great, and they added to their laurels by playing no small part in the battle. From their positions in the tops and on the fore-

castles they kept up a steady flight of arrows upon the French. The arrows carried flasks of unslaked lime which broke on striking the French ships, and the lime dust, borne on the wind, entered the eyes of the enemy and blinded them, the defeat of the French following. The ships of that period were provided with platforms, elevated on wooden pillars, at the bow and stern. The erections were the forerunners of the immense structures which were added in later years and did so much to render ships unstable.

A Venetian ship constructed for Louis IX. of France in 1298, and named the *Roccafortis*, was 70 feet long on the keel and 110 feet over all, with a width at prow and poop of 40 feet. She is stated to have had two decks and a fighting castle at each end. Possibly the weight of the *bellatorium*, as the castle was called, may have necessitated such an extraordinary beam near the bows and stern, but she could never have been built with such dimensions to be other than a floating fortress.

In the Mediterranean, however, great activity prevailed. The Crusades gave a tremendous impetus to the shipping of the Middle Sea. Christians and Saracens vied with each other in the production of ships of war. The larger " busses " sent to the Levant in the fleet of Richard Cœur de Lion carried, according to Richard of Devizes, a captain and fifteen seamen, and forty knights with their horses, forty footmen, fourteen servants, and twelve months' provision for all. Some vessels are said to have carried double this complement and cargo. A Saracen ship, of which little is known, was encountered off the Syrian coast, of so great a size that it could not be subdued until the Christian galleys charged in line abreast and smashed in her side so that she went down with nearly all of her one thousand five hundred men.

A GALLEY OF THE KNIGHTS OF MALTA.

From a Model in the Victoria and Albert Museum.

MEDITERRANEAN GALLEY.

From a Model in the Museum of the Royal United Service Institution.

CHAPTER II

WAR CRAFT OF THE FAR WEST, CENTRAL AFRICA, THE FAR SOUTH, THE PACIFIC, AND THE FAR EAST

NOTWITHSTANDING the enormous strides made in ship construction, it is still possible to find in active use vessels but little removed from the earliest types known. It is, of course, in the "Mysterious East," where anything that served its purpose very well centuries ago seems to have been expected to retain its efficiency for ever, that one finds those survivals from bygone ages. The earliest vessels known were hollowed logs, or dug-outs; such are in use still. Planks were stitched or lashed on above the bulwarks to raise the freeboard and keep out the sea; the same contrivance is applied to this day. A few strips of bamboo or other light material tied together formed rafts; their exact counterparts are in existence in many parts of the world. It was found possible to sail them by means of a sail of matting attached to a yard which was supported by a stout mast destitute of stays or standing rigging; a centre-board or drop keel which could be lowered through the middle of the raft into the water prevented leeway, and steering was effected by means of a pole with a blade attached, usually tied on, this long paddle being sometimes used near the middle of the after end of the raft and sometimes at either of the after corners, the necessary leverage being obtained by the provision of a stump for the purpose. The origin of such rafts is lost in antiquity, yet they continue to be found in active service.

The bark canoes which the Indians of North America employed on the great rivers and lakes when white men first went there are unchanged in their method of construction, and though in places where civilisation and the mechanical arts have assumed sway the old canoes have given way to the products of the modern boat-builders' skill, yet in the farther North-West the Indian canoe ripples the summer surface of the lakes and streams as it did centuries ago. The real Indian canoes were made by building the frame, and then placing upon it a carefully prepared strip of birch bark sufficiently large to cover the entire frame in one piece; it was lashed to the frame and then stitched at the ends to form the bow and stern. The larger canoes were sometimes stiffened by having two or three pieces of wood lashed thwartwise. The canoes were propelled by means of paddles, and the Indians sat or knelt on the bottom of the boat. Many of these canoes weighed as little as 60 lb. and some even less. Their chief use was in the migrations of the tribes between their summer and winter quarters, and very picturesque they must have appeared to the early settlers as a flotilla glided past; that is, if an Indian could ever be regarded by an early settler as anything but "pizen." But these canoes served equally well to convey the painted and feathered braves to battle; and anyone who has seen the Indians in their canoes can well imagine how in days now happily past, it is hoped for ever, a fleet of these boats, filled with cruel and relentless men, passed swiftly and silently over the waters at night, their paddles so skilfully wielded that the blades entered and left the water with never a splash to break the solemn stillness. Then the Indian canoe was no longer an emblem of joyous happiness, made only for the sparkling waters and clear nights and days of that foretaste of Paradise, the Indian summer,

WAR CANOES OF INDIANS OF THE NORTH-WEST.

From a Photograph of a Painting, supplied by the Curator of the Chicago Museum.

fit craft for the romantic passing of Hiawatha to "the kingdom of Ponemah"; but an evil thing, as swift and silent and terrible as the bloodthirsty men it bore to victory or destruction.

The skin canoe or kayak of the Eskimo holds only one person, though its length may be anything from 7 or 8 feet to 25 feet. It is simply a light frame, running to a fine point at either end, never more than a few inches in depth, and with a breadth determined by the breadth of the man who is to use it. It is entirely skin-covered, except for a small hole in the deck, just abaft of amidships, in which the solitary occupant sits. The Eskimo are very clever in the management of their light craft—it weighs but a few pounds, and for its size is probably the lightest sea-going vessel in the world—and employ it chiefly in hunting, even at some distance from land.

The bark canoes of the Australian blacks were very primitive affairs; they have almost disappeared, sharing the fate of the rapidly dwindling aborigines. It may be doubted if a trace of one of these canoes could now be found from one end of the Murray River to the other. Since the blacks saw how easily the white man knocked together a few planks and made a flat-bottomed, straight-sided boat, they ceased to labour at bark canoes, but instead obtained a few boards, usually by pilfering, "borrowed" or begged a few nails, and with a stone for a hammer have done likewise, patching the very leaky seams with anything that came handy, were it scrap of tin, leather, raw hide, or well-greased fragment of a dirty, torn, old blanket, and making up for deficiencies by incessant bailing. Never again on the southern Australian rivers will the bark canoe convey the braves to the scene of the tribal conflict, or ferry in the dying glow of the setting sun the skeleton-painted men to the edge of the grim, dark

forest on the other shore to attend a great corroboree, whether of war, rejoicing, or grief.

Nor have the African negroes made much progress beyond the dug-out stage of war canoe construction. The Moors and Arabs long since proved themselves excellent seamen and shipbuilders, designing boats suitable to their needs, and are in quite another category. The negroes of the Cross River district in Southern Nigeria may be taken as typical of the African canoe makers. They usually chose a mahogany or awosa tree, and, having felled it, burnt it hollow where it fell. It was then dragged on rollers to the waterside and finished with whatever tools were available, matchets, knives and axes being used since the white man's introduction of those implements. Occasionally a canoe is "smoked" or hardened by being exposed to the hot smoke of a fire built round it. Some of the war canoes are as much as 60 feet in length, and are wide enough to allow the men to sit two abreast. The larger ones have a steering platform on a level with the gunwale or raised a foot or two above it, and a smaller platform is placed at the bow, where a flagstaff may also be fixed. When there are no thwarts or seats the crew sit on the bottom of the canoe or on the gunwale, according to the size of the vessel. Both bow and stern overhang. The paddles are made of hardwood in one piece, 3 to 4 feet in length, and are pointed.

It is to the East Indies and the Pacific that we must turn to find the most wonderful examples of the war canoe. They may be divided into two classes: those with outriggers—this section including double canoes—and those without.

Many of the canoes lacked stability, even in calm waters, and the risk of capsizing was greater in waters liable to sudden storms or exposed to the ocean swell. To meet this difficulty and at the same time permit of the continued use of the shallow

A "DUG-OUT" CANOE OF NEW GUINEA.

NEW GUINEA CANOES WITH OUTRIGGERS.

From Photographs supplied by the Hon. J. F. Jenkins.

harbours of their coasts, the Malays are supposed to have invented the outrigger, and this conjecture is based on the fact that wherever the Malay influence is traceable there some form of the outrigger or double canoe is to be found also.

The primitive hollowed log generally constitutes the hull of the canoes of the Pacific Islanders. The rest is mainly a matter of ornamentation. With but few exceptions, the islanders seem to have believed that the higher and more imposing and ornamental they could make the stems or sterns of their vessels, the more dreadful in war were they likely to be. Many of these elevations are beautifully carved; other canoes are merely grotesque, and not a few have no artistic feature whatever to redeem them from absolute hideousness. As a means of terrifying an enemy by presenting such things to his astonished gaze they would doubtless be effective, had it not been that the enemy would retaliate by presenting something equally ugly, with the result that the moral effect which each party sought to exercise upon the other would be neutralised. Some of the islanders are said to have decorated the prows of their vessels with the skulls of opponents killed in previous expeditions; while others contented themselves with locks of human hair, similarly derived, as naval adornments. With the exception of bows, arrows and spears, all their weapons were designed for fighting at close quarters. It must have been a labour of love, as well as a feeling of pride in the appearance of the fearfully shaped and murderous clubs, which led them to carve their weapons as carefully as they did, to render them so deadly, and to adorn them with mother-of-pearl and sharks' teeth. Not a few of the paddles were given serrated edges in order that they could be the more effectively employed as war clubs if necessary.

There are not many native war canoes now left in the

South Seas. None of the islanders, except the head-hunters, habitually kept canoes for war purposes, though at times one would be designed and built for some special expedition. The last of the great Samoan war canoes has almost rotted to pieces on the shore. It is doubtful if it has ever been used in a warlike expedition. It was between 60 and 70 feet in length, and 18 to 20 feet beam over all. It consisted of two large single canoes, placed parallel a few feet apart, and joined by a plank deck which ran across the greater part of the vessels. Amidships was a house-like erection, used as a shelter. It was propelled by oars, but also carried a mast and sails. It could easily carry a hundred men.

The great canoe to hold three hundred men is but a memory ; all that is left of it is its steering paddle, 40 feet in length, which adorns the wall in the Ethnographical section of the British Museum.

The canoes of that mysterious people, the Maori of New Zealand, well repay attention in greater detail than is possible in this book. The origin of the people themselves is unknown, though, if their traditions are to be accepted, they migrated a few hundred years ago from certain of the islands in the Central Pacific, partly conquered and partly absorbed the people whom they found there already, and have remained ever since. There has been more than one such expedition. There are affinities between the Maori and the Hawaians. Did the Maori come originally from Hawaii, or is there some connection between them and the ancient Egyptians, as is held to be indicated by certain points of resemblance in their carvings and mural decorations ? In what sort of canoes did they cross the ocean, and how did they find their way ? Unfortunately, the old chiefs who held the traditions have all died, and it is only owing to the painstaking researches

STEM-PIECE, MAORI WAR CANOE.

STERN-POSTS OF MAORI WAR CANOES.

From Examples in the Dominion Museum, Wellington, New Zealand.

A MAORI WAR CANOE.

Mount Egmont, New Zealand.

of a few scholars who recognised the need and value of preserving what could still be learnt, that anything at all is known of the history of this strange people. Their legends tell us that some of their canoes were of great size; some could carry fires or places for cooking the food, and others were double canoes. One of the latter is said to have had a platform connecting the two hulls, and bearing a house; it was a three-masted vessel. All the New Zealand canoes had names of symbolical or historical interest. One of them was called *Marutuahi*, which, translated literally, means a slaying or devouring fire.* The dimensions of the historical or legendary canoes are not known. The straight, tall kauri pines of the North Island enabled large canoes to be built; one is said to have been 110 feet in length, and many of the later canoes were 60 to 80 feet long, and held a hundred to a hundred and fifty men. These boats had long, overhanging bows ornamented with a figurehead and two carved boards extending some little distance along either bow. Between these boards and resting on the stem the carved figurehead was placed and was often adorned with tufts of feathers. A mast set rather far forward and raking aft supported a triangular mat sail, the foot of which extended along the boom one and a half times to twice the length of its height, and enabled the canoe to sail very near the wind. The stays of the mast and the sheets of the sail were of plaited flax. The drawbacks to these canoes were that having no keels they made great leeway, and that their length made them awkward to manage whenever they were caught in anything like a rough sea; they could not meet the seas end on, but lay in the trough of the waves, and were so well handled that disasters were few. In rough weather they were covered with flax mats

* "The New Zealanders," by George French Angas.

over a portion of their length to prevent the seas breaking inboard.

The long pine hull was of great strength, but to render it more seaworthy topsides were lashed along the sides of the hull from end to end of the vessel with braids of flax fibres,* and the seams and holes were caulked with a species of down. As a precaution against leakage and to strengthen the joint, a long, thin batten was lashed over the outside of the joint.

The decorations of the Maori canoes are wonderful. The spiral pattern often seen in their carvings is taken from the unfolding of the frond of a fern, and has been supposed to symbolise the unfolding of life or the attainment of a planned enterprise. The greatest care and the most artistic efforts were lavished upon the carvings of the prow and stern boards. These boards were very large and always removable. The log from which the stern-board was fashioned was generally about 15 inches in diameter and 6 to 15 feet in length, and in its complete state was covered with conventional and elaborate patterns. The figurehead log was about 6 feet in length and 4 feet wide, and 2 to 4 feet in thickness. Both were of hardwood and coloured red with kokowai or ochre. If the figureheads represented the dead chiefs who had joined the immortals in the Maori heaven, they must have lost in the other world what little beauty was left to them in this world after being tattooed. Not a few of the figures are extraordinarily grotesque, and the weird effect of the red ochre is heightened by the introduction of bright shiny eyes made of the inner shell of the haliotis. Many also show the tattoo marks which were supposed to add to Maori beauty, and most bore bunches of feathers of the kaka and albatross, and on gala days were further adorned with an elaborate and gaudy

* "Maori Art," by A. Hamilton.

A LAKATOI NEARLY COMPLETED.

A LAKATOI UNDER SAIL.

From Photographs supplied by the Hon. J. F. Jenkins.

feather wig. The thin batten, already alluded to, covering the join of the topside and hull, was always stained black. Gannet feathers were inserted to cover the lashings and contrasted vividly with the black batten and the reddened canoe. The sides of many canoes also were painted in wavy lines of red, white and black, as though in imitation of the wave motion. Streamers of pigeon tail feathers hung from the top of the stern-board to the water; even the sail point on the boom bore its tuft and streamers of feathers.

The dug-out, as the type common to all the Pacific islands, usually has the outrigger attached; it can only be used in still waters. Very frequently it is duplicated to form a double canoe, or even three may be used abreast and covered, together with the intervening spaces, with a deck upon which a deck house is erected. As the deck extends a considerable distance beyond the sides the amount of deck space thus obtained is very great, as can well be imagined if the hull be formed of three canoes each 50 or 60 feet long, and the deck extends 3 or 4 feet on either side and is nearly square. If canoes with outriggers were employed as double canoes they were placed with the outriggers lashed together.

The accompanying illustrations of a New Guinea boat or "lakatoi" show how these vessels are arranged. They each carry two short pole masts which support immense spars of bamboo or other light material to which sails of palm leaves are attached. These sails are so constructed that they can be hauled up or down their spars as required. They have been described as suggesting when under full sail gigantic lobsters holding up their claws in distress. The houses upon them are formed of rattan and palm leaves. An idea of their dimensions may be formed by comparing in the illustrations the vessels themselves and the men and women upon them.

Not the least amazing features of these boats are that long sea voyages were undertaken in them, and that in spite of their size not a nail was used in their construction, the whole thing being tied firmly together with coco-nut or other fibre.

The Fijian canoe was very similar to that just described. The Tahitian "pahi" is frequently 80 feet in length, of the raft-boat type, and bears a distinct likeness to the "balsa" of Ancient Peru, and has some of the features of the catamarans of the Chatham Islands, and "has a closer likeness still to a Chinese junk, with its high latticed stern work."* These pahi were broad in the beam, neatly planked over inside, and were fitted with a bulkhead or inner casing, and had the usual elevated carved stern, sometimes consisting of one post and sometimes of two. These vessels were capable of covering 120 miles a day without much difficulty if the wind suited. The Pacific Islanders, says the same authority, "in the early days of Polynesian enterprise (about 1400 A.D. and earlier) would make voyages of over a thousand miles at a time, taking the sun as their compass by day and the moon and stars by night, adapting the time of their sailings to the shifting of the Trade wind . . . veering from north-east to south-west in its appointed season."

Unquestionably the most remarkable canoes to be found in the Pacific were those made in the Solomon Islands. Though destitute of metal tools, the islanders yet managed to design them with mathematical accuracy, to construct them to scale and in accordance with the designs, and to put them together with skill and precision. Such canoes were made by the Solomon Islanders as long ago as the sixteenth century, for de Mendaña, who visited the islands in 1568, has left a description of them. The canoes, he says, were constructed of

* "Eastern Pacific Lands," by F. W. Christian.

CANOE FROM SHORTLAND ISLAND.

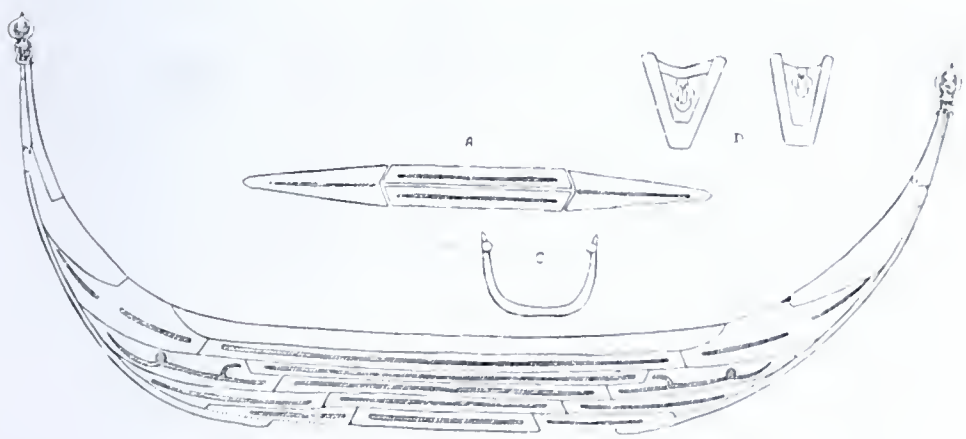


DIAGRAM OF SHORTLAND ISLAND CANOE.

a, The keel. *c*, The timbers. *d*, The small, solid, wedge-shaped timber in bow, with ornament.

By permission of C. M. Woodford, Esq., F.R.G.S., and the Royal Anthropological Institute of Great Britain and Ireland.

WAR CANOE, TESTE ISLAND, NEW GUINEA.

From Photograph supplied by the Hon. Y. L. Jenkins.

planks, well made and light, and were crescent-shaped and capable of holding about thirty persons. Later explorers have recorded that the hull was formed of a dug-out, and that top-sides were added. This type of canoe appears to be peculiar to the Melanesian inhabitants of the British Solomons.* For neatness and accuracy the Shortland Island canoes come first, but "for beauty of line and exterior decorations the large tomako or head-hunting canoe of the New Georgia group unquestionably excels." The built canoes were cut with the aid only of stone implements, but now the natives use the plane iron, fitting it into the handle formerly used for the stone implement. In many canoes a central ridge is left along each plank to strengthen it, and a projecting boss is left at the places where the planks and timbers join. The timbers, or ribs, etc., are either naturally grown or shaped from the solid. The planks are properly seasoned in the building sheds, and when the canoe is being put together the various parts are accurately fitted and tied with strips of fibre through the holes in the bosses. The seams are caulked with a vegetable putty made from scraped nut kernel, which hardens in a few days. The canoes consist of garboard strakes, second, third, fourth, fifth, and gunwale strakes, stem and stern pieces, and the timbers or ribs. The last fine specimen of the head-hunting canoe of the New Georgia group was 44 feet over all, 4 feet 8 inches beam, and 2 feet 4 inches deep. The height of the bow, in addition, was 9 feet 7 inches, and that of the stern 10 feet 9 inches. All the Solomon Islands canoes are ornamented with shells. A white-painted arm on the side of the vessel has a sinister interpretation. It indicates that heads have been taken; if the arm points to the bows the victims were males; and if to the stern the collection taken up was

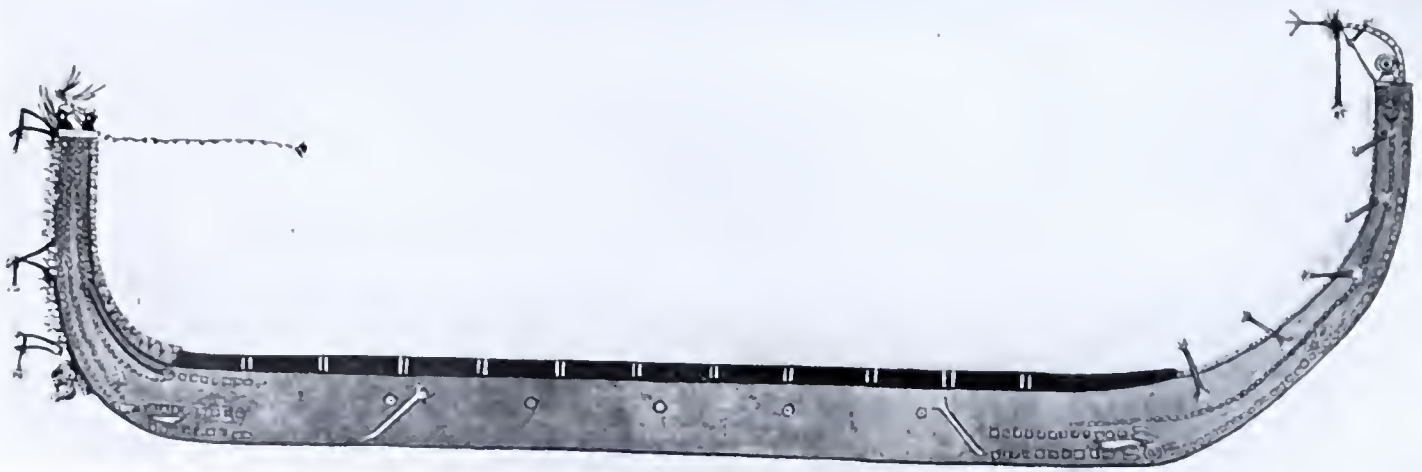
* "Canoes of the Solomon Islands," by C. M. Woodford, F.R.G.S.

of female heads. Both stem and stern-boards had human faces carved upon them, the idea being that the faces kept a good look-out in every direction. This was, no doubt, a pleasing fiction or a superstition; the natives placed more reliance upon their keenness of hearing and vision than upon the vigilance of the wooden faces to detect the approach of an enemy.

The Malay influence has been shown not only in the building of outrigger canoes, but in the popularity of piracy among the natives of the East Indies. Probably the Malays have been pirates ever since there has been commerce in those waters upon which to prey. It is certain that the earliest European vessels to wander into the distant Orient found the industry established, active, and prosperous. Steam navigation, improved firearms, and the electric telegraph have done much to curb the propensities of these merciless marauders, and the influence of noble men like Rajah Brooke of Sarawak has been of equal value. But they found it a hard lesson to learn that commerce must be respected and commercial vessels let alone; it was gradually accepted as inevitable that piratical exploits would be followed by the visit of a European gunboat which would blow every Malay proa and pirate to pieces at the first opportunity. This idiosyncrasy of the Western world had to be observed, but the pirate does not take kindly to the uninterrupted ways of peace, and whenever he can he indulges in his hereditary calling, though his victims may be only small native trading boats and junks.

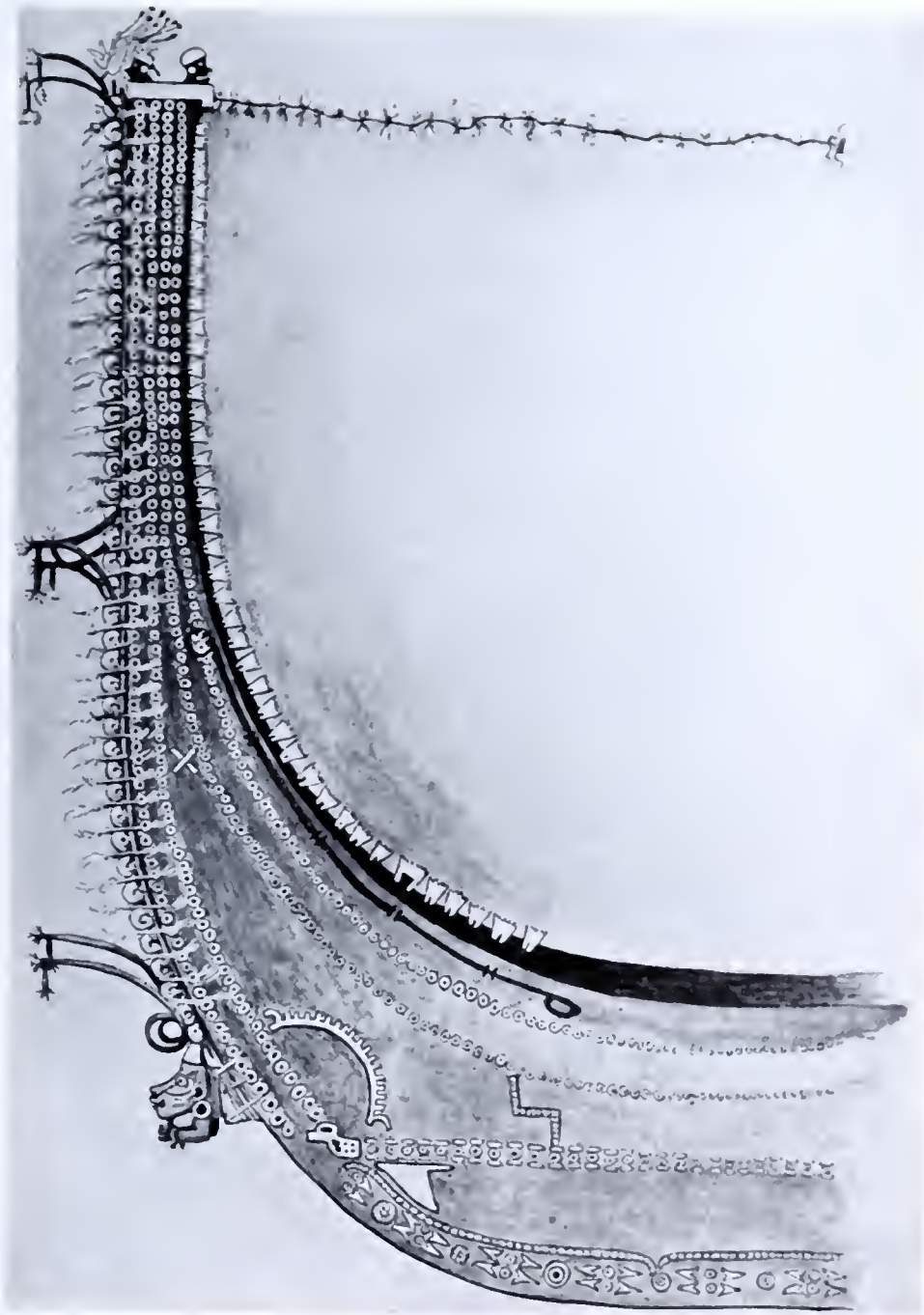
The Malay dug-outs intended for piracy or war were broader than those intended for other purposes. A writer in 1848* described them as built of timber in the lower part, with the upper part of rattan, bamboo, and dried palm leaves, this

* "Borneo and the Indian Archipelago," by F. S. Marryat.



HEAD-HUNTING CANOE FROM YSABEL.

By permission of M. Woodford, Esq., F.R.G.S., and the Royal Anthropological Institute of Great Britain and Ireland.



HEAD-HUNTING CANOE FROM YSABEL (DETAIL OF BOW).

By permission of C. M. Woodford, Esq., F.R.G.S., and the Royal Anthro[illegible] of Great Britain and Ireland

lighter part being added to prevent the sea washing in over the low sides. "Outside the bends," he continues, "about a foot from the water line, runs a strong gallery in which the rowers sit cross-legged." Apparently the gallery was on or outside the gunwale, an arrangement which would help to steady the long, narrow hull. Then, as now, a cabin was placed in the after part for the accommodation of the chief in command of the boat, but an interesting feature of the proa he describes was an unrailed flat roof extending from the cabin roof almost the length of the ship and serving a double purpose of providing a fighting deck for the warriors and affording shelter for the crew. The weapons were the kris and spear, which "to be used with effect require elbow room." As the Malays were energetic fighters, they were seldom long in obtaining all the elbow room necessary. A brass gun in the prow, under the flying deck, was the only firearm.

The modern Malay proa is a more ambitious affair. It is built to be light, fast under sail or oar, and very shallow in hull. The last was very necessary in vessels which usually sought safety by fleeing into waters too shallow to permit of serious pursuit. A convenient length was 64 feet, or 72 feet over all; the breadth would be 14 feet and the depth only 4 feet 6 inches. Some were longer and broader, but the Malays were usually careful to increase the draft as little as possible. The accompanying photograph is of a model of a proa having these dimensions, and recently added to the South Kensington Museum. The boat is a combination of Chinese and Malayan design. It will be noticed that the vessel has very fine lines forward, almost identical with those of the Arab dhows of the Red Sea and the Persian Gulf, a sharp run aft and shallow floors, and should be very fast. Instead of the fighting deck overhead, already described, she has a deck extending the

whole length and breadth of the vessel and slightly below the level of the gunwale, an arrangement which would enable a large number of men to lie concealed behind the bulwarks and ready for instant attack. The deck has two covered hatchways. The roof of the cabin at the stern provides a platform for working the rudder and the guns, there being one brass muzzle-loader on each quarter. The projecting platforms or galleries at the bow and stern provide additional deck space and would facilitate the boarding of a prize. The boat has two pole masts, one set very far forward and the other rather forward of amidships, neither having stays. The sails of all vessels of this class were made of strips of palm leaves, except when the pirates appropriated the sails of captured ships, as they are said to have done at times, and altered them to suit their own vessels. The Chinese type of dropping rudder, which could be raised or lowered by means of a windlass, was a common feature in these Malay proas, the use of the steering paddle being chiefly confined to the smaller craft. The vessel represented is armed with one smoothbore gun carried on the bow platform, and two similar weapons carried aft; she also had six gingals or heavy muskets mounted on swivels, and there was a plentiful supply of arms for hand-to-hand fighting.

A very similar boat to the proa, but more heavily and substantially constructed, was that specially favoured by the Dyaks in their head-hunting expeditions. It was long and narrow, and could carry sixty to eighty men. The Borneo Dyaks adopted the flying deck as a fighting platform,* but carried the fantastically decorated stern-board to an extravagant height, which must have interfered seriously with the stability of the vessel. These stern-boards are said to have

* "Borneo and the Indian Archipelago," by F. S. Marryat.

THE FAMOUS OLD CHINESE JUNK, "WHANG HO."

Photograph supplied by "Shipping Illustrated."

MALAY PIRATE PROA.

From the Model in the Victoria and Albert Museum. By permission of E. Walters, Esq., Ware Priory, Herts.

been intended as shields for the occupants of the boats, who turned them end-on to the enemy and were protected by the boards from the hostile arrows and spears.

The Chinese seem to have attained to a certain degree of civilisation many centuries ago, and then to have gone to sleep. The dwellers along her coasts were traders and, when opportunity offered, pirates, but as China maintained a policy of splendid isolation both under her old dynasties and after her Manchu conquerors assumed control of her destinies, she had little need of a navy and no interest to serve in encouraging a fighting marine. China used guns in land warfare as early as the eighth century A.D., yet in the eighteenth century she had war junks carrying, not artillery, but soldiers armed with bows and arrows, while the sides of the vessels bore leather shields painted to look like tiger heads, to scare the enemy. Some of her junks were propelled by means of a couple of paddle wheels on each side worked by manual power. The Chinese war junks differed from the trading junks in the greater strength of their construction and in the number of guns carried. Some had guns approximating to 68-pounders, and it was not unusual to find a junk with twenty-one guns of varying dimensions. Each was the same cumbersome, slow-moving craft. These vessels were sometimes over 1,000 tons burthen. One of these junks, the *Key-ing*, which visited London in 1848, sailed across the Atlantic from Boston to St. Aubin's Bay in the remarkably good time of twenty-one days, a performance comparing favourably with that of many of the western sailing ships; generally she sailed "like the wind," that is to say, "where it listeth," and was as likely to arrive at one port as another. Another famous junk in her time was the *Whang-Ho*, but whether the junk of that name which started on an exhibition tour of the world two or three years ago was the

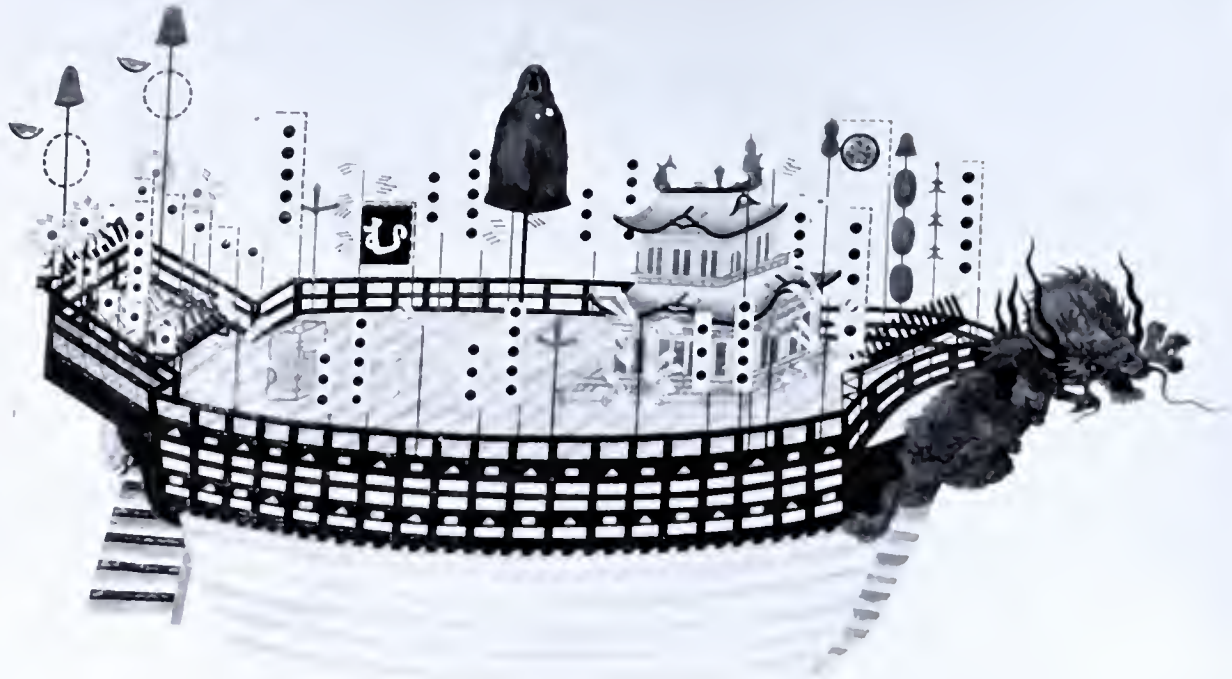
original or was a copy, as is alleged, is a point which is in dispute. She left San Francisco for New York and London, intending to make the voyage by way of Cape Horn, and soon showed that her intended port was about the last place where she might be expected. Instead of New York, she fetched up at Tahiti, where the crew went ashore and stayed. She sailed with a new crew for the stormy waters of Cape Horn, and was thought to have gone to the bottom until she turned up in Torres Straits, and nearly got into trouble through being suspected of smuggling, or carrying contraband. After being nearly wrecked off Java, she entered Batavia River, and sailed again some weeks later, but her condition became so bad that she had to be abandoned. Her captain wrote in his log-book, in October, 1909: "She will not hold together much longer . . . The beams are not fastened to the hull of the vessel, but lie loose in her. . . It is certain she has never been a man-of-war, but has been specially built for exhibition purposes in the most careless fashion." A few days later she was left to her fate.

The Japanese, who pursued a policy of isolation until they were forced to admit Western influences, were as conservative in their shipping as in everything else. Their trading junks were all built to pattern, externally and internally, decreed by the authorities, and no deviation from it was permitted. In their warships, however, a greater variety of design was allowed. As early as the fifteenth century they had sea-going ships carrying cannon, a weapon derived at some time, perhaps, in the unrevealed past, from the Chinese after the latter conferred upon the Japanese the Chinese system of writing, a religious system, and other evidences of Celestial superiority. There were several types of these war galleys, some of which are here illustrated. The vessels shown were generally very

JAPANESE WAR GALLEYS AND A PROTECTED GALLEY 'KIKKOSEN'
15th CENTURY.

Photograph by special permission of the Japanese Imperial Naval Commissioners.

PICTURE OF THE ATAKA MARU POSSESSED BY TOKUCAWA SHOCUN



THE "ATAKA MARU."

Photographed by special permission of the Japanese Imperial Naval Commissioners.

strongly built with a displaecment of about 200 tons. They were propelled by over one hundred and fifty oars, and their gun positions had bulwarks about 4 feet high, protected by thick wooden shields. A smaller type of vessel, also in use at that time, may be called a protected galley. They were very small vessels, displaeing only about 25 tons each. They were nearly flat-bottomed, but had a top covering, or hood, made of metal sheets, which extended from side to side and almost from end to end, like a turtle back. Their guns were mounted inside the cover and fired through small ports cut through the sides of the vessel itself. These boats were two-ended; that is, of similar shape at either end, so that they could travel either end foremost, and they had a curious tunnel constructed along their bottoms in which a peculiarly shaped paddle-wheel was revolved by manual power for the propulsion of each vessel. The Japanese warships increased in size and ornamentation until the *Ataka Maru* was built. She is of more than ordinary interest, as she was the last and the largest of the old native warships built for the Japanese Government before the adoption of Western methods. She was 180 feet long by 63 feet beam and 22 feet depth, and was propelled by one hundred and thirty oars. Her armament consisted of five heavy guns and a number of smaller weapons, and her vital parts were protected by copper sheathing. The Japanese, as already stated, probably obtained their knowledge of explosives and firearms from the Chinese, and a few years ago repaid the obligation by giving the Chinese most instructive lessons in the superiority of modern methods and weapons.

One of the oldest vessels, and at the same time one possessing characteristics supposed to be essentially modern, is the Arab dhow. It is as old as the days of Alexander the Great in its chief features, and in the fineness of the lines of its hull, its

seaworthiness, and its general handiness is not unlike the Viking ships, and is equal to anything of similar size that the average modern builder could produce with the same materials. They are employed in gun-running, smuggling, and the slave trade, when more legitimate cargoes are lacking or not sufficiently remunerative.

The Siamese were among the Eastern nations who took kindly to the sea, and were able to use their warships to some effect. Thus, about two hundred and fifty years ago, when a European power, depending upon its superior strength, took forcible possession of the island of Junk Seylon, the King of Siam of that day ordered the "immediate building of six warships, each carrying ten guns with pattaroes, and well manned and fitted with small arms." These vessels were built in one month, and this emergency mobilisation and the fighting orders were all to be obeyed under penalty of death and forfeiting of estates, the latter penalty being added no doubt to prevent the expectant heirs of a warrior depriving his majesty of the latter's services.

CHAPTER III

THE INTRODUCTION OF ARTILLERY, AND THE DEVELOPMENT OF WARSHIPS TO THE APPLICATION OF STEAM FOR NAVIGATION

Sails having proved their superiority over oars as a means of propulsion, and sailing ships with seaworthy qualities being fairly numerous, the world was ready for a great revolution in naval warfare. The warriors also were about equally divided in the matter of attaek and defence in hand-to-hand eneounter. When man first beeame dissatisfied with his own strength for hurling weapons at his foes he set to work to devise a means of overeoming this diffieulty. His earliest weapon for this purpose was most likely the sling. Bows and arrows held their own in land and sea warfare for many eenturies. Various forms of eatapults were introdueed by the Romans and others, and remained in use for some hundreds of years for hurling heavy stones into the partly deeked ships of their opponents to sink them. The mysterious liquid known as Greek fire, the use of whieh has already been explained, was, in the method of its employment, a form of artillery. It was to the naval warfare of those days what the explosive shell is to modern warfare.

The Moors are credited with having introduced firearms into Western Europe at the siege of Saragossa in 1118 A.D., when they had artillery of some sort; and they are stated to have used the agency of fire to throw stones and darts in their defenee of Niebla at a later date. The nature and origin of the firearms and fire maehine have not been aseertained definitely.

Did the Moors derive their knowledge from the East? They had Eastern connections. Mortars were used in China in the eighth century, which fired large stone balls, and by the twelfth century the Chinese had "wall pieces" or siege guns. They employed explosives in war before the Christian era. These events were certainly long before Western Europe discovered how to make gunpowder.

Cannon, as the term is now understood, was introduced about 1330. Edward III. is credited with having possessed cannon in 1338, but historians differ as to whether he employed cannon of any kind at the battle of Sluys, in 1340, or in any of his later naval engagements. Arrows and stones were the chief missiles; the English relied on their famous cross-bows, and the French upon machines for hurling stones. The latter sent several English ships to the bottom.

The battle of La Rochelle, in 1372, when a combined Spanish and French force defeated the English, is probably the first naval battle in which cannon were used, as some of the Spanish vessels are said to have carried a few. Artillery was certainly used at sea shortly after the middle of the fourteenth century by the Mediterranean countries. The Venetians found it effective against the Genoese in 1377, and its use became very rapidly general from the Levant to Spain.

The earliest guns were simply tubes, not cast, but built of strips of iron or wood held together by rings. They were breech-loaders, the charge being placed in a loosely-fitting chamber. How the chamber was secured and the gun fired are still undecided. The guns were usually innocent of trunnions and were fastened lengthwise upon wooden beams which could be propped up to give them the desired elevation. It has been recorded that in one of the earliest siege operations at which this primitive artillery was employed, both sides were so

SIXTEENTH-CENTURY FRENCH SHIPS.

From an Old Print.

interested in the operation of firing that they ceased exchanging missiles and defiance, and even stopped their personal combats, until after the discharge, when, being much relieved that the stone bullet had inflicted no damage on the assailed castle wall and had wounded no one, they resumed hostilities in the old-fashioned way. In those days one discharge per gun per diem was regarded as sufficient. It was customary to load the piece overnight and fire it in the morning, from which it may be surmised that its moral effects were greater than the material destruction caused. Artillery would have to be in a more advanced stage to justify its use at sea, for no vessels could afford to carry guns which could only be used so infrequently. Nevertheless, the moral effects of gunfire were so evident, especially when weapons were made more powerful and able to inflict serious material damage, that the adoption of the new arm for naval war could not be long delayed, and the time soon arrived when both national and private vessels of any size carried one gun or more. By the middle of the fifteenth century guns on board ship had become common.

The illustration of the model* of a ship of the period 1486–1520 gives a very good idea of what the warships of that time were like. Although the vessel carried guns, the bow and arrow were still relied upon. The archer's panier on the mast had given place to the deep circular top. Castles, however, were provided fore and aft for the archers, and were useful alike for affording them protection and accommodation and a place of vantage whence to discharge their arrows. The vessel is of the same type as the Spanish caravel of the early sixteenth century. From this it may be inferred that the Spaniards went to the north for the designs of their hulls, but preferred to retain the rig with which they were most familiar, the

* The model is in the United Services Museum.

Spaniards depending largely on lateen yards and sails, whereas the model is square-rigged but without the top-sails she ought to carry.

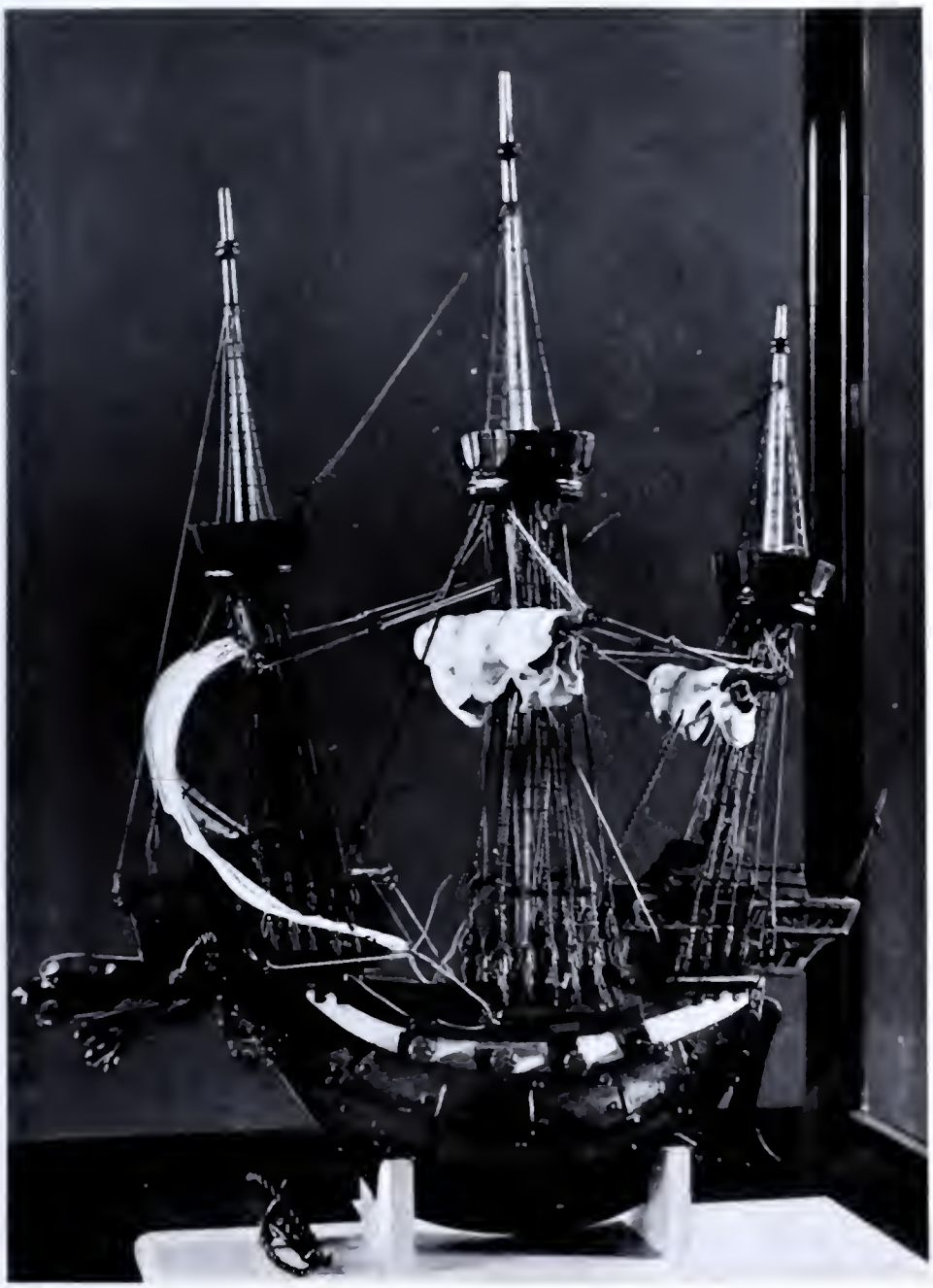
A feature of the sea-going Atlantic vessels of this time was their great beam in proportion to their length. They also had an extraordinary amount of "tumble home," or sloping of the sides above the water line towards each other. Ships of the type represented by the model were much in advance of those upon which artillery was first carried.

Galleys were the first to be equipped with guns, the weapons being upon the upper deck and fired above the bulwarks. Some galleys, particularly in the Mediterranean, carried only one gun forward, a bow chaser. The desire to carry more guns and to fire them over the sides led to the raising of the sides of the vessel; and in order to avoid the strain to the ship's structure when the guns were fired, the weak point apparently being the connection between the sides and beams, the sides were given an inclination inboard, or tumble home, the connecting beams being thus shortened. The practice was carried to such an absurd extent that the beam of a Venetian galleon—as such vessels now began to be called—at the deck might be only half that of the vessel at the water line. The narrower deck space left less room on which to place the stern castle, which instead of being an addition became a structural part of the ship, provided with three and sometimes four decks, all carrying cannon.

On the Atlantic coasts the problem of cannon was solved in its own way. Guns were placed broadside and fired over the bulwark. But the disadvantages of this method were so obvious, especially when an enemy returned the fire, that portholes in the bulwarks were devised through which the guns could be discharged. A French shipbuilder at Brest,

A MEDITERRANEAN WAR GALLEY.

From an Old Print.



SHIP OF WAR, 1486-1520.

From a Model in the Museum of the Royal United Service Institution.

named Deeharges, is said to have been the inventor of port-holes, and also to have designed some other improvements. His portholes, however, were so small that the muzzles of the guns eould only just protrude. It was impossible to give them any traverse, that is, to train or aim them.

The general adoption of artillery led to numerous modifieations in the shape of the ships; they were built of greater dimensions, were more fully masted and rigged, and eould show a eonsiderable press of sail. It was also eonsidered advisable that ships should be built espeeially for war purposes, the Freneh taking the lead after the battle of La Roehelle.

If Henry V.'s warlike enterprises proved harmful to the development of English eommeree, there is no denying that shipbuilding made some progress in his reign, though very little is known of the details of the eonstruetion of the vessels. From lists of the ships employed in his expeditions, it appears that his fleets ineluded "Great Ships," the largest of whieh was the *Jesus* of 1,000 tons, the others being the *Holigost*, 760 tons; *Trinity Royal*, 540 tons, and *Christopher Spayne*, 600 tons; there were also "eogs," whieh were rather smaller; earraeks, whieh were probably foreign built and were prizes of war, the eonstruetion of these vessels not having been then begun in England; ships, barges, and ballingers, the last being barges. The last three elasses were no doubt impressed merehant vessels, ranging from 500 tons in the ease of the ships to 80 tons in the ballingers. In regard to the "Great Ships," it is reported * that Henry, observing the superiority of the Castilian and Genoese ships, eaused some very large vessels, called "dromons," to be built at Southampton, "sueh as were never seen in the world before," says an old writer erroneously, "three of whieh had the names of the

* Fincham's "Naval Architecture."

Trinity, Grace de Dieu, and *Holy Ghost.*" Although called dromons it does not follow that they were similar to the dromons in earlier or contemporary use in the eastern Mediterranean. The name was given to the latter because of their size and speed, and it is very likely that Henry V.'s vessels were so named for similar reasons. Long galleys, called ramberges, were also used about this time, and the English are said to have become very expert in their management.

Most of the large English armed ships of the middle of the fifteenth century were Spanish or Genoese built. A ship was then in existence carrying four guns on the broadside, fired apparently through ports in the bulwarks. She was fitted with four masts and a bowsprit, and had a high forecastle similar to that provided in Italian ships of that period, but seemingly more a part of the structure of the ship than was that of the latter. The mainsail bears the arms of the Earl of Warwick.*

A remarkable ship in the history of naval building was the *Great Harry,* sometimes confounded with the *Henry Grace de Dieu.* The *Great Harry* was commenced for Henry VII., and is regarded by many as the first ship of the British Royal Navy. No doubt the fact that Henry lived for many years in Brittany, which was then remarkable for its maritime activity, gave him a greater interest in shipping than most of his predecessors on the throne professed.

It was a proud day for England, had he but known it, when in the year 1488, he ordered the *Great Harry,* for she marked the first serious attempt of an English sovereign to render the state not wholly dependent upon the merchants and the ports whenever he decided upon an expedition abroad, by providing a vessel which should be at the disposal of the state whenever required. For the first time in the history of England, for the

* John Rous (died 1491) MS. in the Cottonian Library.

building of a national ship, the axes swung as the trees were felled, and the blows resounded through the forests ; the forges roared for the formation of the iron bolts and nails, and the hammers on the anvils rang as they beat them into shape ; the tools of the carpenters hissed as they fashioned the knees and ribs and beams and planks ; the looms whereon the sailcloth was woven hummed in the industrial chorus ; for this was the first ship of England a nation, the first sign that Britannia was really awaking at last to the fulfilment of her maritime destiny. He did not live to see this vessel completed, and she was finished in Henry VIII.'s reign. Henry VII. also ordered the *Regent* and the *Sovereign*. The *Great Harry* is said to have been the first two-decked vessel built in England, and the only ship with three masts in the whole squadron. She was accidentally burnt at Woolwich in 1553.*

The *Regent* was about 1,000 tons, and carried two hundred and twenty-five small guns, called serpentines. She had four masts and a bowsprit, and was launched at Rotherhithe. She was not of English design, but, like a few before her and many since, was modelled after a French vessel. The *Sovereign*, a somewhat smaller ship, carried one hundred and forty-one serpentines. The year 1512 saw the end of the *Regent*. She was the flagship of the English in a notable battle, and was opposed by the great French ship, *Marie de la Cordeliere*, which was provided at the expense of Anne of Brittany, then Queen of France. This ship is stated to have carried one thousand two hundred fighting men, exclusive of mariners ; at this time there were nine hundred on board, according to Derrick, who probably bases his statement on the report that she foundered with all hands numbering nine hundred.

An English description of the engagement states that,

* Derrick's " Rise and Progress of the Royal Navy."

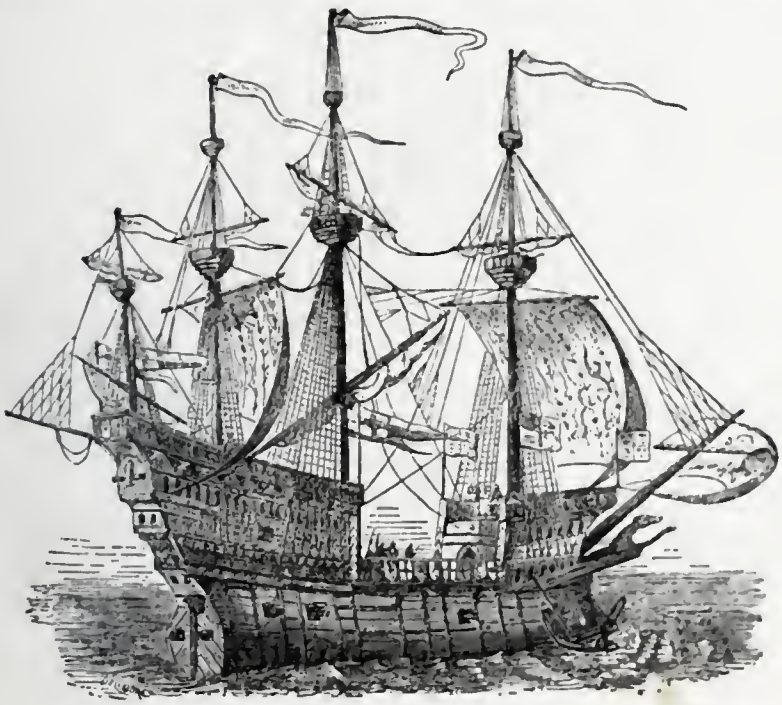
"All things being . . . in order, the Englishmen approached towards the Frenchmen, which came fiercely forward . . . and when they were in sight they shot ordnance so terribly that all the sea coast sounded of it." One of the English ships "bowged," or rammed, the *Cordeliere*, and when at last the *Cordeliere* was boarded, "a varlet gunner, being desperate, put fire in the gunpowder."* The French writer, Guerin, also quoted by the same authority, in his version, says: "In the midst of this general French attack there was to be noted above all others a large and beautiful carrack, decorated superbly and as daintily as a queen. She of herself had already sunk almost as many hostile vessels as all the rest of the fleet, and now found herself surrounded by twelve of the principal English ships. . . . From the top of a hostile vessel there was flung into her a mass of fireworks. Then, sighting the *Regent*, she, like a floating volcano, bore down, a huge incendiary torch, upon her, pitilessly grappled her, and wound her in her own flaming robe. The powder magazine of the *Regent* blew up, and with it the hostile ship. . . . while the *Cordeliere*, satisfied, and still proud amid the disaster, and a whirl of fire and smoke, vanished beneath the waves." The English version, if less vivid, is also less imaginative.

To replace the *Regent*, and to emulate Francis I. of France, who had built a ship called the *Caracon* (afterwards burnt at Havre), carrying one hundred guns, Henry ordered the *Henry Grace de Dieu*, of the same tonnage, 1,000 tons, but carrying one hundred and twenty-two guns. It is disputed whether she was built at Erith, as usually stated, or whether she was launched at Deptford and completed at Erith. Her launch took place in 1515. Historians differ as to what became of this vessel. One version is that she rolled incessantly and

* Grafton's description in Sir W. L. Clowes' "History of the Royal Navy."

EMBARKATION OF HENRY VIII. ON THE "GREAT HARRY."

steered badly, and, having been built rather for magnificence than use, only made one voyage and was disarmed at Bristol and suffered to decay. If this be so, it affords an explanation of the discrepancies in the illustrations of the *Henry Grace de Dieu,* as it is permissible to suppose that another vessel bearing that name was constructed to take its place and that the new-



GREAT SHIP OF HENRY VIII.
(From a drawing by Holbein)

comer afterwards became known as the *Edward.* The *Henry Grace de Dieu* was sometimes called the *Great Harry,* but must not be confused with Henry VII.'s ship bearing that name. The *Henry Grace de Dieu* was renamed the *Edward* after the accession of the next monarch. She had four pole masts; the foremast was placed almost over the stem, an arrangement which must have made her pitch deeply and recover slowly; the mainmast was at the break of the after deckhouse or stern-

castle; the mizen or third mast was midway between the mainmast and the stern, and the fourth, or second mizen, was at the extreme stern, as far aft as it was possible to place it. Her forecastle overhung her bows by 12 feet or so, an arrangement which must have made her very uncomfortable in anything like a sea. She is asserted to have been the first four-masted vessel. There was also a fifth mast, if it may so be called, which slanted forward like an immense bowsprit. The first, second, and third masts had two round tops each, and the fourth mast one top, these being for the archers. Her sails and pennants were of damasked cloth of gold. Her armament comprised twenty-one heavy brass guns, and numerous smaller pieces of various types; but when she passed into the possession of Edward VI. she had nineteen brass guns and one hundred and one of iron.

As already stated, the great majority of the ships built for mercantile purposes were intended to be able to give a good account of themselves if they should be assailed by a hostile vessel, a contingency which was not at all unlikely in the days when ships roved the seas under the protection of letters of marque and made "mistakes" as to the nationality of the prize when the prospective booty might be held to justify the error. Before the nations took to building vessels especially for war every merchant was liable to have his traders requisitioned for war purposes, and even up to the end of the nineteenth century the inclusion of armed merchantmen in national forces was not uncommon. Letters of marque were permits granted to ship owners whose vessels had been despoiled by the subjects of another nation to recoup themselves at the cost of any vessels belonging to that nation which they could capture, and to continue to do so until the losses were made good. Naturally they found this profitable, much more so indeed than ordinary

trading, and did not hesitate to set a low value upon all captures when casting about to find an excuse for another expedition. Piracy, too, was rife, and as at sea every shipmaster was a law unto himself unless there was someone at hand to enforce a change of views, the shipmaster or merchant turned pirate usually flourished exceedingly until captured red-handed, when his shrift was like to be a short one.

As an instance of the license to which this liberty was extended, may be mentioned the Barton family who, in the fifteenth century, had granted to them letters of marque to prey upon the Portuguese in retaliation for the murder of John Barton, who was captured and beheaded by Portuguese. His sons conducted the enterprise with such thoroughness that they were able to pay their Scottish Royal master so well that they were never interfered with by him, and when he entrusted them with the task of reducing the Flemish pirates who levied toll on Scottish commerce, they sent him a few barrels filled with pickled human heads to show that they were not idle. The fame of this Scottish family became world wide, for they had now a powerful fleet and traded and fought and captured where they would, so that the reputation of the Scottish navy was great. One of the ships of the Barton family, the *Lion*, was second in size and armament only to the *Great Harry* itself. The death of Sir Andrew Barton is commemorated in a well-known ballad.

When vessels with two and more decks were constructed, the lower ports were cut so near the water that when the vessel heeled, or even a moderate sea was running, the guns could not be worked. The ports of the *Mary Rose*, which was the next largest ship to the *Regent*, at one time, and had a tonnage variously stated at 500 and 660 tons, though afterwards surpassed by the *Sovereign*, 800 tons, *Gabriel Royal*, 650 tons,

and *Katherine Forteless*, or *Fortileza*, were but 16 inches above the water. She was lost, in 1545, through the water entering her lower ports when going about off Spithead, and her commander and six hundred men went down with her; the *Great Harry* had a narrow escape from a similar disaster at the same time.

A report on the Royal Navy in 1552 makes interesting reading. The fleet was overhauled, and twenty-four "ships and pinnaces are in good case to serve, so that they may be grounded and caulked once a year to keep them tight." This is endorsed, "To be so ordered, By the King's Command." Other seven ships were ordered to be "docked and new dubbed, to search their treenails and iron work." The *Mrs. Grand*, a name which no longer adorns the "Navy List," a vessel carrying a crew of two hundred and fifty men, and having one brass gun and twenty-two iron guns, lying at Deptford, was recommended to be "dry-docked—not thought worthy of new making"; so she was ordered "To lie still, or to take that which is profitable of her for other Ships." Six others were stated in the report—a document seemingly the work of a naval reform party—to be "not worth keeping," but they were ordered "To be preserved, as they may with little charge."

Queen Elizabeth, whose patriotism and naval enthusiasm were about equally in evidence, was careful of her men and ships, raised the pay of her officers and seamen, and took steps generally to have the navy and the naval resources strengthened and conserved. She seems to have had twenty-nine vessels in 1565. She also encouraged merchants to build large vessels, which could be converted into warships as occasion required. The exigencies of trading over sea, however, were such that many of the vessels required little to be done to them in the

BREECH-LOADING GUN RECOVERED FROM THE WRECK OF THE "MARY ROSE."

In the Museum of the Royal United Service [illegible] is shown in the fr[illegible]

way of conversion. Vessels were also rated at from 50 to 100 tons more than they measured.

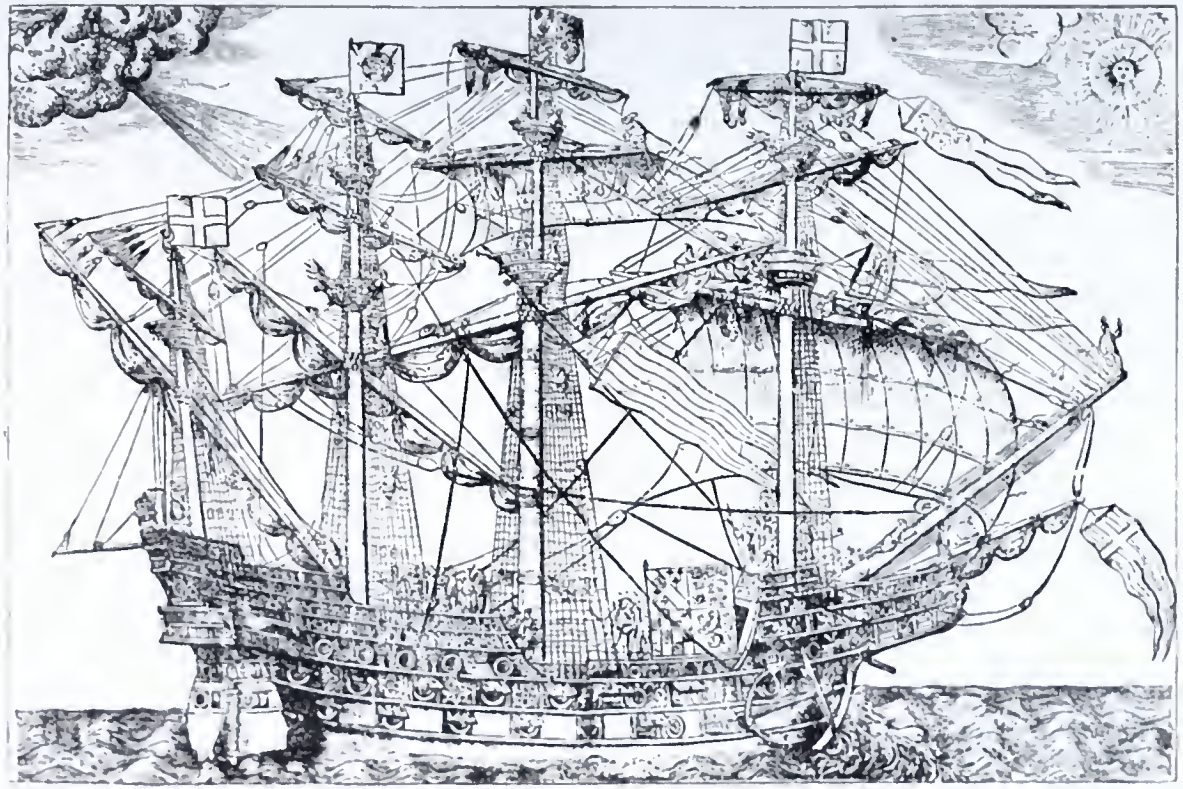
"The Queen's Highness," a contemporary historian writes,* "hath at this present already made and furnished, to the number of One Hundred and Twenty Great Ships, which lie for the most part in Gillingham Road. Beside these, her Grace hath other in hand also; she hath likewise three notable Galleys, the *Speedwell*, the *Tryeright*, and the *Black Galley*, with the sight whereof, and the rest of the Navy-Royal, it is incredible to say how marvellously her Grace is delighted. I add, to the end that all men should understand somewhat of the *great masses of treasure* daily employed upon our Navy, how there are few merchant ships of the first and second sort, that being apparelled and made ready to sail, are not worth one thousand pounds, or three thousand ducats at the least, if they should presently be sold. What then shall we think of the Navy-Royal, of which some one vessel is worth two of the other, as the shipwright has often told me."

Queen Elizabeth had, in 1578, twenty-four ships ranging from the *Triumph*, of 1,000 tons, built in 1561, to the *George*, of under 60 tons.

When the Spanish Armada arrived in the Channel in 1588, the British fleet, which numbered one hundred and ninety-seven vessels, included thirty-four belonging to the state. The remainder were ships of various kinds and sizes, mostly small, hired by the state or provided by private owners, and fitted out hastily for war purposes by their owners or the ports. The Cinque Ports, it should be remembered, which furnished a considerable number, were obliged

* Harrison's "Description of Britain," printed in 1577, and quoted by Hume.

by Henry VIII., in return for certain privileges, to supply him with fifty-seven ships, each containing twenty-one men and a boy, for fifteen days once a year at the ports' expense, and it often happened that the ports had to find a greater number of vessels. After the fifteen days they received state pay. A similar arrangement held good at the time of the Armada. The largest ships in the English force are sometimes stated to have carried fifty-five or sixty guns, and one may have carried sixty-eight guns. The armament of the *Triumph,* which was the heaviest armed English vessel, comprised four cannon, three demi-cannon, seventeen culverins, eight demi-culverins, six sakers, and four small pieces. The *Elizabeth Jones,* of 900 tons, built in 1559, carried fifty-six guns, and the *Ark Royal,* Lord Howard's flagship, launched in 1587, had fifty-eight guns and a crew of four hundred and thirty men, her tonnage being 800. The principal royal ships and the number of guns they carried were, as far as can be ascertained accurately: *Ark Royal,* fifty-five guns; *Lion,* thirty-eight; *Triumph,* forty-two; *Victory,* forty-two; *Bonaventure,* thirty-four; *Dreadnought,* thirty-two; *Nonpareil,* thirty-eight; *Rainbow,* forty; *Vanguard,* forty; *Mary Rose,* thirty-six; *Antelope,* thirty; and *Swiftsure,* forty-two. The Spanish ships were rather floating fortresses packed with soldiers, and desiring to come to close quarters so that the fight should be of the hand-to-hand description to which they were accustomed. The English ships were smaller, and though more numerous, of little more than half the total tonnage of the Armada, and were, on the whole, more lightly armed. Still, a large number of the English vessels carried what were long, heavy guns for those days, and they used them at short range when they assumed a windward position and attacked the Spanish rear, inflicting great



THE "ARK ROYAL," THE ENGLISH ADMIRAL'S FLAGSHIP

damage and throwing the enemy into confusion. This defeat definitely established the cannon as the principal weapon for warfare afloat, and inaugurated a new era in the history of the world's fighting navies.

Of the merchant ships engaged, the largest were the *Leicester*, sometimes called the *Galleon Leicester*, and the *Merchant Royal*, each of 400 tons. The great galleys and galleasses of the Armada were not the largest ships afloat by a great deal, for they were far exceeded in size by many contemporary merchantmen in the Mediterranean.

The Queen's ships were sometimes employed upon peaceful and ambassadorial errands. The voyage of the *Ascension* to Constantinople shows a definite attempt to spread English prestige in distant seas by means of English trade openings, instead of by the diplomacy of the day, a prominent feature of which was the discovery of means and opportunities of raiding a state having much portable riches and not sufficient power to protect them.

The *Ascension*, in which Queen Elizabeth sent her second present to the Sultan of Turkey, left London in March, 1593, and arrived in August, 1594. She was "a good shippe very well appointed, of two hundred and three score tunnes (whereof was master one William Broadbanke, a provident and skilfull man in his faculties)." Some days after the arrival when the wind suited, "our shippe set out in their best manner with flagges, streamers, and pendants of divers coloured silke, with all the mariners, together with most of the Ambassador's men, having the winde faire, and came within two cables' length of this his moskyta,* where (hee to his great content beholding the shippe in such bravery) they discharged first volies of small shot, and then all the great ordinance twise over, there

* Mosque.

being seven and twentie or eight and twentie pieces in the shippe."*

The early part of the seventeenth century, when James I. was king, saw a remarkable advance in shipbuilding, thanks to Phineas Pett, who dropped the somewhat haphazard rule-of-thumb methods of ship construction and introduced a more or less scientific system of measurement and estimate of weights. In 1610, the *Prince*, or *Prince Royal*, of 1,400 tons, and mounting sixty-four guns, was launched. She is described as "Double-built," which has been supposed to mean that she had an outer and inner skin and an additional number of beams, etc. This may afford a partial explanation of the fact that though seven hundred and seventy-five loads of timber were estimated to be necessary for her construction, one thousand six hundred and twenty-seven loads were used. Also, as the ship only lasted fifteen years, a possible further explanation of the discrepancy may be found in the suggestion that much of the timber supplied and included in the larger amount was unfit for use. The *Prince Royal* was "most sumptuously adorned, within and without, with all manner of curious carving, painting and rich gilding, being in all respects the greatest and goodliest ship that was ever built in England." In 1624 this ship had two cannon-petro, six demi-cannon, twelve culverins, eighteen demi-culverins, thirteen sakers, and four port-pieces.

Good sea fighters as the English had proved themselves to be, they yet were behind the Dutch and French as naval architects. Sir Walter Raleigh, an outspoken critic of the King's ships and of English merchant vessels, comparing the latter with those of the Dutch, nevertheless admitted that

* "Queen Elizabeth and the Levant Company," by Rev. H. G. Rosedale, M.A., from Hakluyt Papers. 1904.

THE "SOVEREIGN OF THE SEAS."

From the Model in the Royal Naval College Museum, Greenwich.

THE "PRINCE ROYAL."

Designed by Phineas Pett

By permission of the Elder Brethren of Trinity House.

some progress had been made in English shipping. "In my own time," he writes, "the shape of our English ships hath been greatly bettered. It is not long since the striking of the topmast hath been devised. Together with the chain pump, we have lately added the Bonnet and Drabler. . . . To the courses we have devised studding sails, top-gallant sails, sprit-sails and topsails. The weighing of anchors by the capstan is also new. We have fallen into consideration of the length of cables, and by it we resist the malice of the greatest winds that can blow. We have also raised our second decks." The last improvement was one of the most important, for the space between the decks was cramped, and the lower deck was not much above the water level. The raising of the decks gave the ships more freeboard and increased their seaworthiness, rendered the lower tier of guns more effective by enabling them to be used with less danger from water entering the ports, and gave the men working the guns on the lower tier more head room.

A list of the ships of King Charles, dated 1633, is of more than usual interest, says Derrick, "this being the earliest list of the Navy I have met with, wherein any part of the ships' principal dimensions are inserted. . . . This is the first list in which any nice regard seems to have been paid to the tonnage of the Ships. Previous to 1663, the tonnage of almost every Ship seems to have been rather estimated than calculated, being inserted in even numbers."

A natural development of the *Prince Royal* was the *Sovereign of the Seas*. These two vessels may be regarded as marking the first and second stages in the final period of transition from the old style of warship to the wooden walls. She was a remarkable vessel in national as well as naval history, for she played not a small part in the agitation over the question of

ship-money, which had such a tremendous influence on the nation's development.

"This famous vessel," Heywood states in his publication addressed to the King, "was built at Woolwich in 1637. She was in length by the keel 128 feet or thereabout, within some few inches; her main breadth 48 feet; in length, from the fore end of the beak-head to the after end of the stern, *a prora ad puppim*, 232 feet; and in height, from the bottom of her keel to the top of her lanthorn, 76 feet; bore five lanthorns, the biggest of which would hold ten persons upright; had three flush decks, a forecastle, half-deck, quarter deck, and round house. Her lower tier had thirty ports for cannon and demi-cannon, middle tier thirty for culverines and demi-culverines, third tier twenty-six for other ordnance, forecastle twelve, and two half-decks have thirteen or fourteen ports more within board, for murdering pieces, besides ten pieces of chace-ordnance forward and ten right aft, and many loop-holes in the cabin for musquet-shot. She had eleven anchors, one of 4,400 pounds weight. She was of the burthen of 1,637 tons. . . . She hath two galleries besides, and all of most curious carved work, and all the sides of the ship carved with trophies of artillery and types of honour, as well belonging to sea as land, with symbols appertaining to navigation; also their two sacred majesties' badges of honour; arms with several angels holding their letters in compartments, all which works are gilded over, and no other colour but gold or black. One tree, or oak, made four of the principal beams, which was 44 feet, of strong serviceable timber, in length, 3 feet diameter at the top and 10 feet at the stub or bottom.

"Upon the stem head a Cupid, or Child bridling a Lion; upon the bulkhead, right forward, stand six statues, in sundry postures; these figures represent Concilium, Cura, Conamen,

Vis, Virtus, Victoria. Upon the hamers of the water are four figures, Jupiter, Mars, Neptune, Eolus ; on the stern, Victory, in the midst of a frontispiece ; upon the beak-head sitteth King Edgar on horseback, trampling on seven kings."

The *Sovereign of the Seas* was the largest vessel yet built in England, and though she was intended as much for show as use, she became, when she was reduced a deck and a lot of this ornamental flummery was removed, one of the best fighting ships in the navy, and was in nearly all the chief engagements in the war with Holland, and proved herself a very serious opponent, as the navy records show.

It was about this time that ships were first rated or classified according to their size and efficiency as fighting units. About this time also, a new type of vessel, the frigate, was introduced into the navy. The frigate is not a British invention, but, so far as this country is concerned, was copied from the French by Peter Pett, son of Phineas Pett, who saw one in the Thames. He built, in 1649, the *Constant Warwick* to the order of the Earl of Warwick, who intended her for a privateer, but sold her.

According to Pepys, the Dutch and French, in 1663 and 1664, built two-decked ships with sixty to seventy guns, and lower decks four feet above the water. The English frigates were narrower and sharper, and their lower gun ports were little more than three feet above the sea. It was therefore decided that the English ships should have their gun ports about four and a half feet from the water. The French and Dutch three-deckers were usually about 44 feet in the beam, as compared with the 41 feet of some of the English third rates, and the *Henry*, built in 1656, and the *Katherine*, in 1674, to mention only two of many, were useless until they were girdled, and after 1673 the three-decked second raters were ordered to be 45 feet in the beam.

In the seventeenth century the *Royal Louis* was built at Toulon, carrying 48-pounders on its lower deck, 24-pounders on the middle deck, and 12-pounders on the upper deck. The French, indeed, were taking the lead in naval construction at this period, and their superiority was recognised by the English who captured and imitated them whenever possible. Thus the *Leviathan,* built at Chatham, was a copy of the *Courageux* of seventy-four guns, and the *Invincible,* captured by Lord Anson during the Seven Years War, served as model for many more.

During a French visit to Spithead in 1673, the *Superbe,* seventy-four guns, attracted special attention. She was 40 feet broad and had her lowest tier of guns higher from the water than the English frigates. Accordingly the *Harwich* was built by Sir Henry Deane as a copy, and gave such satisfaction that she was adopted as a pattern for second and third rates. Besides the six rates of fighting ships, other classes were included in the navy list, these being, in Charles II.'s reign, thirteen sloops, one dogger, three fireships, one galley, two ketches, five smacks, fourteen yachts, four hoys, and eight hulks.

The dimensions determined upon in 1677 for ships of one hundred, ninety and seventy guns were sometimes exceeded; and in 1691 another set of dimensions, for ships of sixty and eighty guns, was established. In the following year an appropriation for "bomb vessels" was sanctioned; and about 1694, a revival of the fireships was tried. These vessels were called infernals, possibly on account of their contents, which included "loaded pistols, carcasses (filled with grenadoes), chain shot, etc., and all manner of combustibles." Their revival, or invention in this form, is attributed to an engineer named Meesters, who directed the operations against Dunkirk, without achieving any success with them.

Prior to the battle of La Hogue, in 1692, five advice boats appear in the navy list for the first time; they carried from forty to fifty men each and were deputed to acquire information of the enemy's movements at Brest.

Complaints were made in 1744–5 that the British vessels compared unfavourably with those of other nations in scantlings, seaworthiness, and armament. This induced the adoption of another set of rules, and the ships built according to them proved to be good sea boats, carrying their guns well, and standing up stiffly under sail, but they had the objection of being too full in the after part of their under body, which retarded their speed somewhat. After ten years' trial this establishment was modified, the faults complained of were remedied, and the ships were increased in size, and from this time onward fifty-gun ships were seldom classed as ships of the line of battle. There has been some misconception in regard to the frigates of the period, as many small vessels carrying eighteen guns, or less, were so called, but were afterwards included among the sloops.

The real frigate was a vessel constructed to cruise in all weathers, and able to show a good turn of speed; she had an armament which was fairly heavy for her size, and it was carried on one deck, with the exception of a few guns which might be disposed about the poop or forecastle. For over two hundred years vessels of this type were held in the highest esteem, until, indeed, they were superseded, in common with all other sailing warships, when steam was adopted. The career of the steam frigate was brought to an early close by the adoption of the ironclad.

The frigate itself underwent considerable development during its two centuries' career. The earlier frigates carried twenty-four or twenty-eight 9-pounders, and a crew of about

one hundred and sixty men ; these vessels were about 500 tons burthen, or a little more, with a gundeck length of 113 feet and a length of 93 feet on the keel. Their rig marked a curious transition stage from the Mediterranean influence to that of the modern square rig, as, although they carried square sails on the fore and main masts, lateens were still carried on the mizen. The frigate of thirty-two 12-pounders appeared shortly afterwards, the first of this size being the *Adventure,* launched in 1741 ; and six years later the *Pallas* and *Brilliant,* thirty-six-gun frigates, were added to the navy ; but, while admittedly excellent fighting cruisers, they were inferior to the French thirty-six-gun frigates built about that time.* The frigates played a most important part in the world's naval history of the latter part of the eighteenth century and the early years of the nineteenth century.

Tougher antagonists than the French frigates, however, were the seven frigates the Americans built when matters became strained between the United States and this country ; they were the *United States, Constitution, President, Constellation, Congress, Chesapeake,* and *Essex.* The first-named was the largest, with a tonnage of 1,576, and the smallest the *Essex,* 860 tons. The American navy consisted only of about a dozen vessels altogether on which reliance could be placed, but these were among the best of their kind afloat ; there were a few others of little or no fighting value. The frigates carried batteries of carronades supplemented by long guns, 12-pounders. It was the custom to give the American ships more guns than they rated. Thus the forty-four-gun frigate had thirty long 24-pounders on the main deck, two long bow chasers on the forecastle, and twenty or twenty-two 32-pounder carronades, as in the *Constitution,* while the carronades of the *President*

* Sir W. L. Clowes' " History of the Royal Navy."

and *United States* were 42-pounders. The armament of the *Constellation, Congress,* and *Chesapeake* was twenty-eight long 18-pounders on the main deck, two similar guns on the forecastle, and eighteen 32-pounder carronades. The "ship-sloops," of which the greater part of the rest of the American naval force consisted, carried 32-pounder carronades, and long 12-pounders for bow chasers. The "brig-sloops" were equipped with carronades. The Americans claim to have been the first to employ the heavy frigate effectively, notwithstanding that the cannon balls their guns fired were of less weight in some instances than the projectiles discharged from the corresponding weapons in the British or French navies, and the shot would also appear to have been really lighter than they were supposed to be by as much as two to ten per cent. These frigates were remarkable for the series of duels they fought with British warships, winning six in succession, by superior seamanship and better sailing qualities, to some extent, but mostly by superior gunnery, until the final duel was won by the *Shannon* in her memorable encounter with the *Chesapeake.* The series of American victories was inaugurated by the *Constitution,* otherwise "Old Ironsides," the British victim being the *Guerrière.*

In considering the development of the warships of other types, it is necessary to go back a few years. The British dockyards were unequal to the demands upon them for the wars of the latter part of the eighteenth century, and a greater number of warships than ever before was built by contract at privately owned yards.

It is interesting to note that one firm of shipbuilders which built ships for the navy in those days and even a century earlier, on Thames side, is still in existence, and in spite of limited liability company laws and the introduction of new

partners, is still known as Green's yard, at Blackwall, and is still managed by bearers of the name.

Twenty-six sail of the line and eighty-two smaller vessels were launched from private yards during the war ending in 1762, and twenty-four sail of the line and twelve smaller ships were launched at the King's yards between the declaration of war in 1756 and the proclamation of peace seven years later. This is of importance as showing the resources of the country even at that time in warship building, and the assistance the government was glad to receive from the private builders at times of emergency.

During this war it was decided that no more eighty-gun three-deckers or seventy-gun or sixty-gun ships should be built. In place of the first-named, ships of seventy-four and sixty-four guns were ordained, and fifty-gun ships with a roundhouse were ordered to replace the latter. The first seventy-fours and sixty-fours were too small for the weight of the guns they had to carry, and their successors of that class were larger. No eighty-gun ship with three decks was built after 1757, and no seventy-gun ship after 1759. The *Cæsar* was the first English eighty-gun ship with two decks; she was built in 1793.

Towards the end of 1778 many of the second rates were given eight additional guns on the quarter deck, which virtually raised them to ninety-eight-gun ships. An important constructional improvement in 1783 was the adoption of copper fastenings in all classes of ships below the water-line; iron bolts had been found to corrode under the influence of the salt water.

Ships continued to increase in size and power of armament. The *Ville de Paris*, of one hundred and ten guns and 2,332 tons, and her sister ship, the *Hibernia*, ordered in 1790, were the

first of their class. Before the latter was finished she was lengthened and her tonnage raised to 2,508 tons. Another new class, introduced about that time, comprised three ships of 776 tons each, carrying thirty-two guns, the main deck armament consisting of 18-pounders; they did so well that several others were added.

About 1783 a greater length in proportion to beam was adopted, which made the ships faster sailers and better sea-boats, and several vessels of the higher classes were altered, and many others had their bottoms specially thickened to withstand stranding. The 42-pounder guns of the largest ships were found difficult to handle and of less rapidity of fire than the 32-pounders, and were removed from the main deck battery of the *Royal Sovereign* and other ships in favour of the 32-pounders.

The *Commerce de Marseilles*, of 120 guns, was one of the French vessels which accompanied under compulsion the combined English and Spanish squadron from Toulon in 1793. She was considered to be the largest ship in the world. Her gun-deck was 208 feet 4 inches in length, and her keel for tonnage 172 feet 0⅛ inch. Her depth of hold was 25 feet 0½ inch, and her extreme breadth 54 feet 9½ inches, her tonnage being 2,747 tons. She was not a very valuable acquisition, however, for her timbers were in such a state that she was not worth repairing; she was accordingly taken to pieces in 1802. Probably, like many more vessels built in those strenuous times, she was constructed of unseasoned timber, or had a quantity of immature or soft wood put into her in order that she might be got ready for war as quickly as possible, for warships were wanted in such a hurry that it was more necessary that they should be available for use at the earliest opportunity than that they should be expected to last for very long. Both the

British and French fleets had a number of these "green" ships.

If the French could have a vessel of such gun power and dimensions there was no reason why the English should not, so the *Caledonia*, of 2,602 tons, was ordered in 1794, and was to be the largest and most powerful yet built in England. Her main deck guns were to be 32-pounders, because of the greater ease with which they could be handled. On her lower deck she had thirty-two of these guns, on the middle deck thirty-four 24-pounders, on the main deck thirty-four 18-pounders, on the quarter deck sixteen 12-pounders, and on the forecastle four 12-pounders. Her officers and crew numbered eight hundred and seventy-five. Her length was 205 feet, breadth 54 feet 6 inches, and depth of hold 23 feet 1 inch. She was the favourite ship of Lord Exmouth. At first she had a square stern, but when the rounded sterns were shown to be better in every way she was altered to the new mode, and her armament was revised. She afterwards became the hospital ship at Greenwich under the name of the *Dreadnought*. The model of her at South Kensington shows that her rigging was probably unique. Her royal masts were fidded, that is, built above the topgallant masts instead of forming one long pole with them, as is the custom, and there were also peculiarities in the arrangement of some of her running rigging. This ship was launched at Devonport in 1808.

The defeat of the Danes at Copenhagen, the battle of the Nile, the "glorious first of June," the battle of Trafalgar, the duels of the American War, and the battle of Navarino, united to give a splendid termination to the career of the wooden warship as a fighting unit. That of Trafalgar was the last in which great fleets of the best "wooden walls" that human skill could devise opposed each other in manœuvre and counter-

manœuvre. That of Navarino, fought in a bay, almost in a dead calm, with the ships hardly moving and some even at anchor, was the last conflict in the world's history in which the wooden battleships of the East and the West lay alongside each other and blazed away with every available weapon at a range so close at times that they could not possibly miss.

Constructionally, wooden battleships had about attained the limit of size. Already they revealed unmistakable signs of longitudinal weakness, and it had been a problem, which the builders up to that time had been unable to solve, how to stiffen the hulls so that they would withstand the hogging and sagging strains. It was not until Sir Robert Seppings introduced his system of ship construction that the difficulty was overcome, but the increase in the deadweight of the ship was great. Still, had it not been for his system it would have been impossible to construct some of the later vessels which left the ways before steam was introduced and iron was adopted for ship construction. Very few vessels were built larger than those which fought in Trafalgar Bay, though several were designed. The improvements made were rather in the form of the underbody in order to increase the speed and sea-going qualities of the ships. One of the largest old-style battleships ever proposed was the *Duke of Kent*, which was to have been a four-decker carrying one hundred and seventy guns, and having a tonnage of 3,700. She was to have been given a length of 221 feet 6 inches on the gun-deck, an extreme breadth of 64 feet, and a depth of hold of 26 feet. On the lower deck she was to have had thirty-six 32-pounders, and a similar complement on the lower middle deck; thirty-six 24-pounders on the middle deck; thirty-eight 18-pounders on the upper deck; ten 12-pounders and six 32-pounder carronades on the

quarter-deck; and four 12-pounders and four 32-pounder carronades on the forecastle. Though she never progressed beyond the paper stage, these particulars are interesting as showing what the naval architects of a hundred years ago were prepared to design.

The *Queen* of one hundred and ten guns, the first three-decker launched after Queen Victoria's accession, the *Vernon* of fifty guns, and *Pique* of forty guns, and others of various classes were designed by Sir W. Symonds, who, during his fifteen years' surveyorship to the Admiralty, was responsible for no fewer than one hundred and eighty vessels. The finer lines he gave them increased their speed, and they were broader, loftier, and roomier between decks than their predecessors, and were better ships all round. They may be regarded as embodying the highest degree of excellence to which the sailing wooden warship attained.

Reference has been made to the guns used on shipboard at various times, and to the establishment of dimensions or rates to be observed in building the ships employed in the British Navy. The guns about to be described were used in all navies; the establishments referred to are peculiar to the British Navy, though the vessels themselves differed but little from those belonging to other nations. It must also be remembered that though the names of the guns were retained through century after century, very little is known of the earliest weapons, and that their names came to be applied to guns which had little in common.

The establishments, as they were called, were adopted to secure uniformity in types, and it is well to bear these details in mind, or at least to refer to them, in studying the history of the achievements of the British Navy in order that an approximately correct idea may be obtained of the ships and weapons

used by and against Great Britain which have had so great an influence on the world's history.

The principal establishments were ordered in 1677, 1691, 1706, 1719, and 1745, and certain proposals were also made in 1733 and 1741, which were not of quite so far-reaching a character as the others. The establishment of 1745 was not adhered to for many years, and there has been no cut-and-dried establishment since, the requirements of modern warfare and the inventiveness of all nations having militated against adherence to a rigid standard. Ships of one hundred guns were in length on the gun-deck in 1677, 165 feet; in 1719, 174 feet; in 1745, 178 feet; their extreme breadth was 46 feet in 1677, and 51 feet in 1745, and the burthen increased from 1,550 tons in the first-named year, to 2,000 in the last. The ships of ninety guns had lengths on the gun-deck of 158 feet, 164 feet, and 170 feet in the three years respectively; their extreme breadth was 44 feet, 47 feet 2 inches, and 48 feet 6 inches, and their tonnage 1,307, 1,569, and 1,730 tons. The three-deckers of eighty guns first appear in the 1691 establishment; they were 156 feet on the gun-deck, 158 feet in 1719, and 165 feet in 1745; their extreme breadths at the three dates were 41 feet, 44 feet 6 inches, and 47 feet, and their burthens 1,100, 1,350, and 1,585 tons. Seventy-gun ships increased from 150 feet in length in 1677, to 160 feet in 1745, their breadth from 39 feet 8 inches to 45 feet, and their burthens from 1,013 tons to 1,414 tons. Ships of sixty guns were 144 feet in length in 1691, and 150 feet in 1745, with respective breadths of 37 feet 6 inches, and 42 feet 8 inches, and tonnages of 900 and 1,191 tons. Fifty-gun ships appear in the ratings of 1706 with a length of 130 feet, and in 1745 of 144 feet; their respective breadths being 38 feet and 41 feet, and tonnages 704 and 1,052 tons. In the same year also, 40-gun ships are recorded with a length

of 118 feet, an extreme breadth of 32 feet, and a tonnage of 531 tons; these dimensions had risen in 1745 to 133 feet, 37 feet 6 inches, and 814 tons. Ships of twenty guns were rated in 1719 with a length of 106 feet, breadth 28 feet 4 inches, and tonnage 374; increased by 1745 to 113 feet, 32 feet, and 508 tons.

In regard to their complements, a 100-gun ship in 1677 carried seven hundred and eighty men; in 1733, eight hundred and fifty; and in 1805, eight hundred and thirty-seven men. Ships of ninety and ninety-eight guns had, in 1677, six hundred and sixty men; in 1706, six hundred and eighty men; in 1733, seven hundred and fifty men; and in 1805, seven hundred and thirty-eight men. An 80-gun ship carried in 1692, four hundred and ninety men; in 1706, five hundred and twenty; in 1733, six hundred; in 1745, six hundred and fifty; and in 1805, seven hundred and nineteen men. A 74-gun large class ship had in 1762, six hundred and fifty men; and in 1805, ten less; a 74-gun common class ship had, in 1745, six hundred men; in 1762, six hundred and fifty men; in 1783, six hundred; and in 1805, five hundred and ninety men. A 70-gun ship had in 1677, four hundred and sixty men; in 1706, four hundred and forty; in 1733, four hundred and eighty; and in 1745, five hundred and twenty men. A 64-gun ship in 1745 had four hundred and seventy men; in 1762, five hundred; and in 1805, four hundred and ninety-one men. A 60-gun ship had in 1692, three hundred and fifty-five men; in 1706, three hundred and sixty-five men; in 1733, four hundred; and in 1745, four hundred and twenty. A 50-gun ship had in 1706, two hundred and eighty men; in 1733, three hundred; in 1745, three hundred and fifty; and in 1805, three hundred and forty-three. A 44-gun ship carried in 1733, two hundred and fifty men; in 1745, two hundred and eighty; in 1783,

three hundred men ; and in 1805, two hundred and ninety-four men.

Very little indeed is known of the earliest types of firearms carried afloat. The crudeness of the methods of manufacture, and the absence of any standard for pattern or size, left the makers free to produce whatever weapons they fancied. The *Christopher of the Tower*, in June, 1338, is said to have had three iron cannon with five iron chambers. The guns were breechloaders, and the chambers contained the charge and perhaps the projectile. She also had a hand-gun, which, though fired from the shoulder, had the barrel supported by a rest standing on the deck, after the manner of the hand-guns in use ashore. The *Mary of the Tower* was equipped with an iron cannon provided with two chambers, and a brass gun with one chamber. None of the weapons yet discovered show how the chambers were fastened in the guns of this period. It is known that they fitted loosely and that the chambers could be fired, if necessary, without the guns.

The early naval guns were called "crakys of war."* They included cannon-paviors, or guns which threw round stone shot, and appropriately named murtherers, which were smaller weapons and were loaded with anything that could be fired out again.

An inventory of the *Great Barke* as "vyeuwyd" in the twenty-third year of King Henry VIII., is preserved in the Cotton Library at the British Museum. The following are extracts :—

"Hereafter followeth the ordinances pertayning to the sayde shype, item, in primis, two brazyn peeys called kannon peeys on stockyes which wayith The one 9 c. 3 q. 11 lb., the other 10 c. 1 q. 17 lb., whole weight 20 c. 28 lb. : Item 2 payer of shod wheeles nyeu : item two ladyng ladells.

* "Encyclopædia Britannica," 9th Edit.

"Starboard side. Item oon port pece of yeron cast with 2 chambers: item a port pece of yeron, with one chamber. Item a spruyche slyng with one chamber.

"Larboard side. Item oon port pece with 2 chambers: Item another port pece, with oon chamber, whyche chamber was not made for the sayd pece.

"In the forecastell. Item a small slyng with 2 chambers. Item another pece of yeron with two chambers, the oon broken."

Even in Queen Elizabeth's day much of the artillery had to be imported from Germany. It was not until about 1531 that iron guns were first cast in England, and brass guns were cast three or four years later. Guns were made of greater weight and bore when it was discovered how to cast them instead of building them, and muzzle-loaders gradually superseded the old breechloaders. The change, however, was slow, and was probably retarded by the reluctance of those ship owners who had breechloaders to discard them while they could yet be fired, a reluctance which no doubt extended, owing to the paucity of weapons, to the rulers of the various states.

The guns of the sixteenth century were extraordinarily varied. The largest was the cannon-royal of rather more than $8\frac{1}{2}$ inches diameter,* 8 feet 6 inches in length, and weighing about 8,000 lb.; its charge of powder was about 30 lb., and its shot weighed 74 lb. The cannon was 8 inches diameter, weighed about 6,000 lb., and with a charge of 27 lb. threw a shot of 60 to 63 lb. The cannon-serpentine was of 7 inches diameter, weighed 5,500 lb., and with a charge of 25 lb. threw a shot of 42 lb. The bastard-cannon was of about the same length as the cannon-serpentine, but a lighter weapon, and though the charge of powder was 5 lb. less, the weight of

* The diameter of this and other guns referred to in this section is that of the bore.

the shot was the same. The demi-cannon varied from a little under 6½ inches diameter to 6¾ inches, and was about 11 feet in length and weighed about 4,000 lb., and with a charge of 18 lb., threw a projectile weighing from 31 to 33½ lb. The bore of the cannon-pedro, or petro, was 6 inches, its weight about 3,800 lb., its shot, usually of stone, whence its name, from 24 to 26 lb. The diameter of the culverin was from 5¼ inches to 5½ inches, its length was close upon 11 feet, its weight 4,840 lb., it received a 12 lb. charge, and fired an 18 lb. shot. The basilisk was slightly shorter and lighter, and its 14 lb. shot required 9 lb. of powder. The diameter of the demi-culverin was 4 inches, its weight 3,400 lb., its charge was 6 lb., and its shot 8 to 9½ lb. The culverin-bastard seems to have been of half an inch larger bore, about 8½ feet long, but to have been 400 lb. lighter than the demi-culverin, and to have fired an 11 lb. shot with a charge of 5¾ lb. The saker, or sacar, was a far smaller weapon, being less than 3¾ inches diameter, under 7 feet in length, and weighing about 1,400 lb.; its charge was 4 lb., and its shot 4 to 6 lb. The minion, slightly smaller in all respects, threw a 3 lb. to 4 lb. shot. The falcon was of 2½ inches diameter, 6 feet long, weighed 680 lb., and fired a 2 lb. shot with a charge of a little over 1 lb. of powder. The falconet was a smaller edition of the falcon. The serpentine was of 1½ inches diameter, weighed 400 lb., and fired a ½-lb. shot; and the rabinet, or robinet, was an even lighter weapon.

For loading, canvas or paper cartridges were used, but an iron ladle for the powder was preferred. The following list of commands in the gun-drill contrasts oddly with what would pass in the turret of, say, a modern super-Dreadnought:—

"Search your piece; sponge your piece; fill your ladle; put in your powder; empty your ladle; put up your powder;

thrust home your wad; regard your shot; put home your shot gently; thrust home your last wad with three strokes; gauge your piece."

Some curious guns were invented when the ordnance industry was in its infancy. The Scots in a southern raid in 1640 used guns of leather at their passage of the Tyne—which says more for the strength of the leather than of the powder. A composite affair called the "kalter" gun, introduced in the time of Gustavus Adolphus, of Sweden, is described:—

"A thin cylinder of beaten copper screwed into a brass breech, whose chamber was strengthened by four bands of iron, the tube itself being covered with layers of mastic, over which cords were laid firmly round its whole length and equalised by a layer of plaster, a coating of leather, boiled and varnished completing the piece."*

Another peculiar weapon was a twin gun, in shape something like a stumpy tuning-fork, with parallel barrels and one touch-hole; another was a gun which could be fired at either end, the cavity in which the chambers were placed being in the middle. It must have been an awkward piece to handle. Hand grenades, used sometimes preparatory to boarding, were introduced in 1689 during William III.'s reorganisation of the artillery.

Even when the ships were provided with guns, opinion was by no means unanimous as to the extent to which the weapons should be employed, or the range at which they would be most effective. The method in vogue on the Atlantic was to shoot as soon as it was thought the enemy could be seriously damaged. A gentleman named Gibson, who reported on the condition of the British Navy in 1585–1603, is quoted by Charnock as saying:—

* Chesney's "Observations on Firearms."

GUNS OF THE FIFTEENTH AND SIXTEENTH CENTURIES.

In the Tower of London.

ANCIENT DOUBLE GUN.

In the Museum of the Royal United Service Institution.

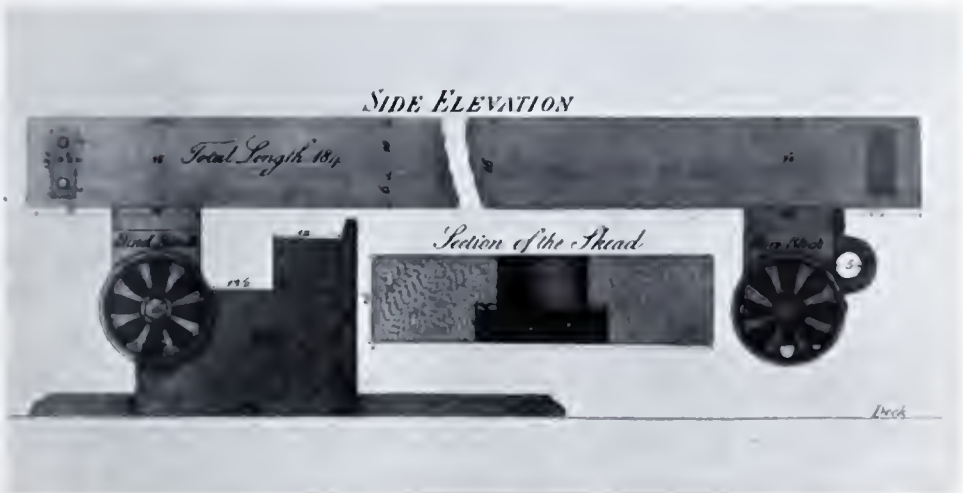
"Be sure it is your enemy before you shoot, and that you are in halfe gunnshott of your ennemy before you shoot. It is direct cowardice to shoot at greater distance, unless he is running away. British gunns being for the most part shorter, are made to carry a bigger shot than a French gun of like weight, therefore the French gunns reach further, and those of Britain make a bigger hole. By this the French have the advantage to fight at a distance, and we yard-arm to yard-arm. The like advantage we have of them in shipping (although they are broader and carry a better saile) our sides are thicker and the better able to resist their shott. By this they are more subject to bee sunk by gunnshott than wee are."

The Mediterranean custom was different. The Marquis of Villafranca, whose advice was sought by Don John of Austria, thought there should not be more than two discharges before the galleys close, that the arquebussiers should not fire the second time until the blood of the man hit should splash back in their faces, and that the noise of the discharge should coincide with the ramming of the hostile vessel. But all the guns employed in the Mediterranean sea-fights were not of this order. In the tremendous struggle between the Cross and the Crescent much heavier artillery was used. One siege gun is said to have thrown a shot of 160 lb. During this struggle the Knights of Malta, after the capture of St. Elmo by the Turks, when the latter dishonoured the bodies of the slain knights, retaliated by beheading their Turkish prisoners and firing the heads back into the camp of the besieging Turks. The Knights combined unswerving fidelity to their principles and their masters, when they acknowledged any, with the utmost bravery, ferocity, and cruelty. There was little to choose between the leaders on either side, but the palm must be given to the Mohammedan leaders for their fertility of

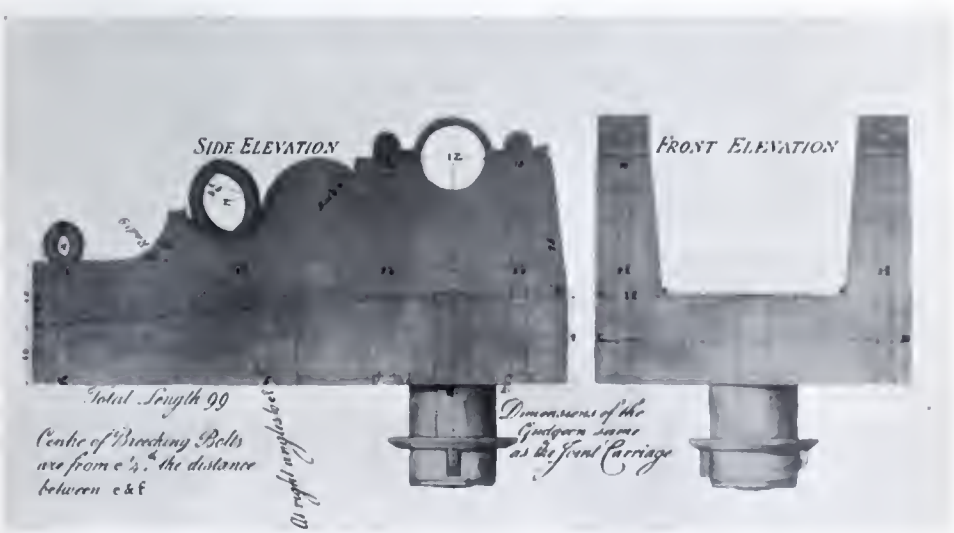
resource in extricating themselves from apparently hopeless situations. The chief of these were the brothers Barbaroussa, one of whom made himself King of Algiers, and they and others of the band were the greatest of the Barbary pirates, dreaded from one end of the Mediterranean to the other. The elder Barbaroussa and his worthy successor, Dragut Reis, became the chief admirals of the Turkish forces, the latter being killed in that terrible struggle at Malta in which St. Elmo fell, a fate which was only averted from the whole fortress by the remarkable genius of the greatest commander the knights ever possessed. By way of commemorating the services of the brothers Barbaroussa, the present Turkish government has named after them the two second-hand German warships it recently bought.

In the latter part of the seventeenth century the cannon were probably 42-pounders, the demi-cannon 32-pounders, and the culverins 18-pounders. Before an effort was made to systematise the armament of ships, hardly any two vessels carried the same number of guns. It was proposed in 1677 that a first-rate should carry twenty-six cannon with eight men to each ; twenty-eight culverins, with five men to each ; twenty-eight sakers on the upper deck, four on the forecastle, and twelve on the quarter deck, with three men to each saker ; and two 3-pounders with two men each. A second-rate should carry twenty-six demi-cannon, with six men to each ; twenty-six culverins ; twenty-six sakers on the upper deck and ten on the quarter deck ; and two 3-pounders, with the same number of men to the guns as a first-rate. A third-rater should carry twenty-six demi-cannon, twenty-six 12-pounders with four men to each ; four forecastle and ten quarter deck sakers, and four 3-pounders. The remainder of the complements was to consist of two hundred and ninety-six men, two hundred and

CARRONADE OF SIX DIAMETERS.



CARRONADE.



THE CARRONADE AND ITS CARRIAGE.

From Drawings supplied by the Carr

sixty-two men, and one hundred and sixty-two men for the three rates respectively, giving grand totals of seven hundred and eighty men, six hundred and sixty men, and four hundred and seventy men.

About the beginning of the seventeenth century the practice was introduced and has been retained ever since—with the exception of the later guns, which are indicated by their weight or the diameter of their calibre—of describing the guns by the weight of their shot.

A remarkable advance in the science of gun-making was shown when the carronade was introduced by the Carron Company. Briefly, this weapon may be described as a short heavy gun, carrying a heavy shot, and using a moderate charge of powder. It was a wonderfully destructive weapon at short range, and as a broadside gun held its own well into the middle of the nineteenth century. A favourite carronade was that of six diameters, one of which is here illustrated; that is, the length of the bore was six times the diameter of the calibre at the gun's mouth.

These guns were made in two or three patterns. One was the familiar swivel, another had the trunnions below the gun centre so that the gun rested upon them, and the third and most common was that with the trunnions at the sides. The carriages, too, were exceedingly ingenious, being devised to permit of meeting the recoil as well as adding to the facility of handling the weapon, and the sighting arrangements did not leave the gunner much opportunity of going wrong provided he obeyed the instructions.

It was customary to fire a round, solid iron shot from these guns. On one occasion a very different missile was employed. An armed merchantman was overtaken by a privateer, and being short of cannon balls, the cargo was broached. The

first missile hit the side of the privateer and smashed. The second hit a mast, dented it, and flew to pieces. Another missile smashed itself and a privateersman's head at the same time, and the enemy then hauled off, wondering what new projectile had now been discovered. The merchant ship had defended itself with round Dutch cheeses—a testimony alike to the ingenuity of her commander and the strength of the missiles.

The East India Company had several vessels built in the Far East, and great was the outcry at the proposal that Indian-built ships should be included in the British Navy. However, the success which attended the armed ships of the Company, such, for instance as the *Grappler,* launched at Bombay, in 1804, was responsible for the launch of a "beautiful frigate" at Bombay, called *The Pitt,* the first ever built in India for His Majesty's service.* A picture of her is in the Guildhall Museum, London.

The merchant vessels of the East in the seventeenth century were usually built of teak and well armed, and if they were not particularly fast sailers—some were particularly slow—they were usually able to withstand the shot of all but the heaviest guns which the pirates and privateers carried who infested those seas. Some of the greatest French naval heroes were men who were dreaded from one side of the Indian ocean to the other.

One of the vessels constructed in those days and still afloat is the sailing ship *Success,* which, after an eventful career, was one of the "floating hells" in which convicts were imprisoned near Melbourne for some years, then became a coal hulk, was somehow saved from destruction when her

* "Asiatic Register of the Progress of Shipbuilding in the Territories of the East India Company."

equally evil companion ships were ordered to be broken up, was turned into an exhibition ship showing her as a prison ship, was scuttled in Sydney harbour, raised again, and has since toured the world. She saw active service about a hundred years ago, and still bears on her tough sides the marks of the enemy's cannon balls. She is probably the last of her type afloat. The East Indiamen and the West Indiamen of the seventeenth and eighteenth centuries invariably carried guns, and needed them.

It is strange to think how recently the policing or safety of the seas has been secured, for the Liverpool newspapers contained, even in times of peace, advertisements that vessels would sail with the convoy, and that such and such a warship would act as escort.

Even along the British coasts the Carron Company armed its schooners, and offered special inducements to those passengers who were willing and able to assist the crew to repel a possible attack.

CHAPTER IV

STEAM AND WARSHIPS

The use of the steam engine as a propellant had been established in the mercantile marine long before the British Admiralty led the way in the adoption of the steamship as an engine of war. There were several reasons why the decision to take the important step was not reached earlier. In the first place there was a repugnance, amounting with many persons to an unconquerable aversion, against the use of the steamship for any purposes whatever. Steamships were regarded as unsightly with their splashing paddle-wheels and their high funnels belching forth smoke, and as the steam mercantile marine had been by no means free from boiler explosions and had lost many vessels through fires caused by sparks or cinders from the furnaces, or the overheating of wood work near the flues, it was argued that the introduction of so many fresh dangers into the country's fighting ships would only add to the perils of the sea, which were already serious and numerous enough.

The navy possessed many fine wooden ships which could be handled extremely smartly under sail and presented a magnificent contrast and beautiful picture compared with the smoky steamer. The latter, it was graciously admitted, might have its uses in towing the sailing warships, but that anything further should be advocated was too subversive of all that had gone before ; too revolutionary, indeed, to merit a moment's consideration.

It was in vain that the advocates of the adoption of steam propulsion urged that the steamship could carry guns, that she would be independent of wind and tide, and that she could choose her own position. These strategical advantages were simply derided. What, it was asked in reply, could a small steamship armed with such guns as she could carry, do against a battleship; or, for that matter, what could any number of armed steamships do? When it was pointed out that an armed steamship could engage with every advantage an enemy's ship of the same size, the retort was that a battleship would never be far off. Strange though these objections seem to us in the light of subsequent events, it must be recollected that marine steam engines in those days were bulky for their power and weak for their weight, and consumed an enormous amount of coal for the energy developed, and that there was no room to spare in the fighting ships of the period; also, that the steam engine was not far removed from the experimental stage. For the first twenty-five years of the nineteenth century the Admiralty had every excuse for the maintenance of its conservative attitude.

In America, also, the objections to steam war vessels were as acute as in this country. One United States secretary of the navy declared that he would never consent to see the beautiful sailing warships displaced by hideous and smoky steamers, but the advocates of the new method of ship propulsion were not of his opinion, and so worried the worthy man that in despair he wrote to a sympathetic friend, "I am steamed to death." Another and earlier American administrator was so opposed to warships of any kind, or at least to spending much money on their construction, that he conceived the brilliant idea of having some small gunboats built which could be taken overland from port to port and

launched afresh, when necessary, to oppose the British warships. It is a pity he could not have derived some inspiration from the invention of Oliver Evans, an American, who in 1804–5 designed a dredger which bore the terrible name of *Orakter Amphibolos ;* it had a steam engine of some sort, and propelled itself on wheels from the shed where it was built, to the Schuylkill, a distance of a mile and a half, and being fitted with a paddle wheel in the stern, navigated the river to its junction with the Delaware.*

France, like England, was disposed at first to look upon the steam engine as useless for naval purposes, and until well towards the middle of the nineteenth century she was a long way behind England in the application of steam power to the navy. Many of the smaller nations, however, having but a few insignificant sailing ships for war, were not trammelled, as were England and France, by the possession of a large fleet of wooden sailing vessels of types which had helped to build up the national renown, nor had they to contend against the energy of a powerful section of the community which, conscious of what had been accomplished with the sailing warships, despised anything else and hated innovations. The smaller nations were the better able, therefore, to experiment with warships of the new type than were the great maritime powers, and one or two of them ordered small steamers carrying a few small guns. These were mostly converted merchant steamers, it not being until after England and France had definitely adopted steamers that the other nations ventured to possess steamships specially built for purposes of war.

But when steam navigation had become an accomplished fact and steam-propelled vessels were able to undertake ocean voyages, there was the less excuse for the absolute rejection

* Appleton's " Cyclopedia of American Biography."

of steam-driven ships for war purposes. The objections raised, and they were certainly serious, were that the paddle-boxes were large and increased the size of the target at which the enemy could aim, that one or other of the paddle-wheels could easily be disabled by a hostile shot, in which case the steamer would be almost helpless, and would be entirely so if both wheels were disabled; that the engines and boilers, being partly above the water-line, were peculiarly vulnerable, and that the only vessels of a size capable of being propelled by paddle engines were too small to be of much fighting value.

Long before steam engines were adopted in any form in the navy, numerous experiments had been made in the mechanical propulsion of warships, and some extraordinary methods were brought forward. The remarkable feature of nearly all these experiments is that they would propel a vessel; but the inventors could not be taught, except by the bitter lesson of experimental failure, that an appliance which might attain a certain measure of success with a small boat or a model might be incapable of developing sufficient power to propel a larger vessel. Several inventors, both in this country and America, tried what they could do with oscillating paddles at the stern. Manual power was tried on the frigate *Doncaster* at Gibraltar, in 1802, to drive a "perpetual sculling machine," invented by a man named Shorter, and a speed of something under two miles an hour in still water was obtained.

Certain of the early experiments in America had an important influence upon the development of the steam warship, though the proof of that influence did not become evident for many years.

Colonel John Stevens, who had a small, screw-propelled steamboat on the Hudson, in 1804, and a twin-screw steamer in the following year, designed, in 1813, an iron-clad ship

which fully embodied the *Monitor* type, and was the first ironclad ever worked out for construction. It was Stevens who sent the first steamer on a sea voyage; his vessel, the *Phœnix*, being shut out of the waters of New York by the monopoly which Fulton and his friends had secured, went round to the Delaware by sea in June, 1809, experiencing a gale on the way, which compelled her to seek shelter in Barnegat Inlet.

Of Fulton's early experiments and failures in the matter of submarines and torpedoes it is unnecessary to speak. In 1814, some years after his return to the United States from Europe, where he had been impartially offering his services to the French and then the British, he submitted to the American coast and harbour defence committee plans for a steam warship which was to carry a large number of guns.

The boat was launched in October of that year and given the pedantic name of *Demologos*, which was simplified to *Fulton the First*. The war ended before the vessel could be tested, and she became a receiving ship. Her machinery was arranged to drive a large paddle-wheel, placed amidships and working in a tunnel in the hull. She was to carry twenty guns, not forty-four as sometimes stated, and furnaces for red-hot shot, and was to travel at a rate of four miles an hour. Besides her deck armament it was proposed that she should have two submarine guns suspended from each bow, which were to send a hundred-pound ball into an enemy's hull ten or twelve feet below the water-line. Her machinery was intended to pump a tremendous column of water upon the enemy's decks and through the latter's portholes. Her gun-deck was completely covered over so that no hostile shot could reach it from above. Her wooden walls were five feet in thickness, and capable of withstanding the heaviest shot of the day. The

dimensions of this remarkable craft were: length, 156 feet; beam, 56 feet; and depth, 20 feet; but her draught, loaded, was only 10 feet. The water-wheel, the position of which is indicated in the centre of the accompanying plan of the gun-deck, was 16 feet in diameter, and had blades or buckets measuring 14 feet with a dip of 4 feet. The cylinder of the engine measured 48 inches, and the stroke was of 5 feet. The boiler was 22 feet long by 12 feet beam, and 8 feet deep. The gross tonnage of the vessel is set down at 2,475 tons. The ship was two-masted, and could steam either end foremost. She was built at Brown's yard at New York, in four months after her keel was laid, and given her machinery and guns at Fulton's works on the North River.

Another vessel, destined like the *Demologos* never to see active service, but which, nevertheless, was the first iron-clad steamer actually built, was the ship designed, in 1841, by Edwin A. Stevens, a son of John Stevens, at the time that hostilities were feared between England and the United States.

Mr. J. Elfreth Watkins, in an address before the Philosophical Society of Washington, in 1892, said:—"As thick armour plate could not be made at that date, he devised the method of armour plating in laminæ, or plates laid over each other and riveted. He then made a series of experiments to determine the thickness of plating required to resist the different sizes of balls then in use. From these experiments, which were made at Bordentown, N.J., in the summer of 1841, he made the deduction that a target of iron 4½ inches thick would resist a 64 lb. shot, at that time the heaviest ball used in our navy."

This standard of thickness was afterwards adopted by European naval architects for warship iron armour.

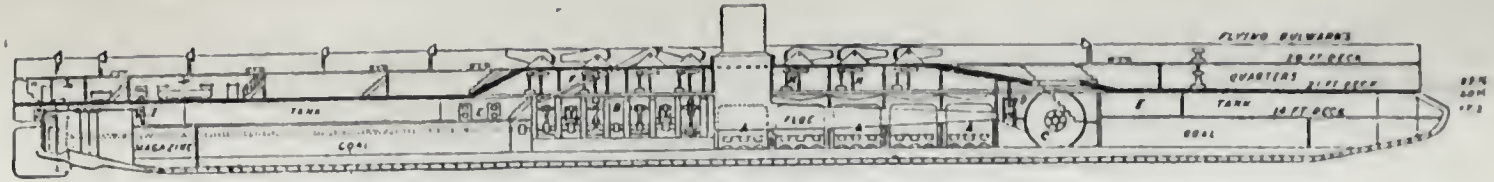
A committee of naval and military officers was appointed

which made numerous tests, and as a result Congress entered into a contract with Stevens for the construction of "a war steamer, shot and shell proof, to be built principally of iron," and making an appropriation for the purpose.

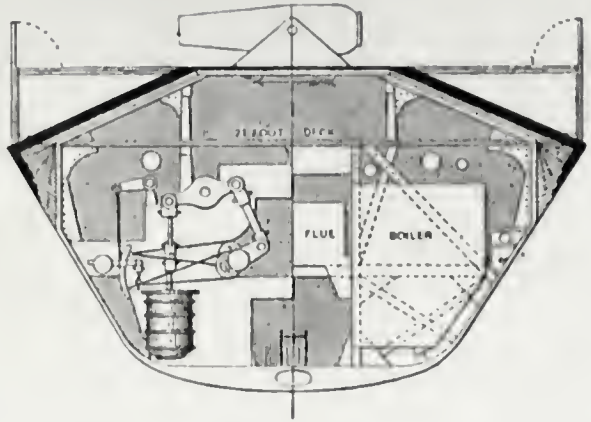
Up to this time there had been but little change in the power of guns since the time of Nelson, but Commodore R. F. Stockton's successful construction in England of a wrought-iron gun throwing a round shot able to pierce a target 4½ inches thick, induced Robert Stevens, who was associated with Edwin A. Stevens, to alter the plans and increase the thickness of the armour so as to fulfil his contract to build a ship that should be "shot and shell proof."

The production of still more powerful guns, both in America and Europe, caused more alterations and delay. It is of interest to note the dimensions of this vessel in order to see to what an extent Stevens anticipated the designs of some later engineers. When Robert Stevens died, in 1856, the ship was then 410 feet long, 45 feet inside the armour shell, with two feet of freeboard, and with a square, immovable turret enclosing depressible guns. She had her engines and boilers, and it would not have taken long to complete her; but for some reason, which need not be gone into here, except that the vessel was too far in advance of the officials at Washington, who were wedded to wood and sail, she was never launched, and was ultimately sold in 1881 for old material. Besides being armoured and turreted, she had a powerful ram of the "axe-head" pattern.

A writer in the *Cosmopolitan Magazine* for May, 1898, says:— "That the Stevens battery would have been irresistible as a ram and invulnerable as a fort is easy to be seen; but the Stevenses were condemned in this case by official obstruction to undeserved failure. . . . During these years, though



ELEVATION



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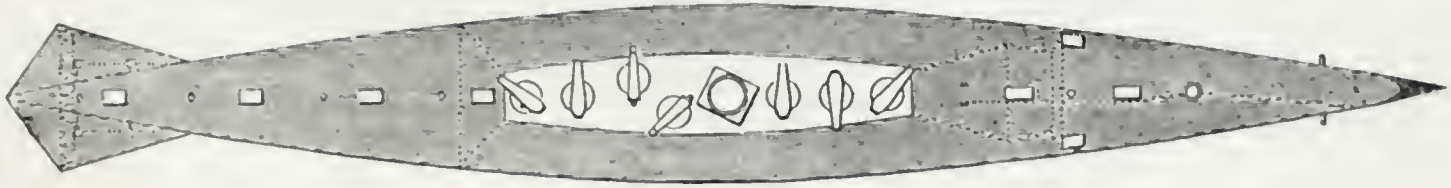


PLAN

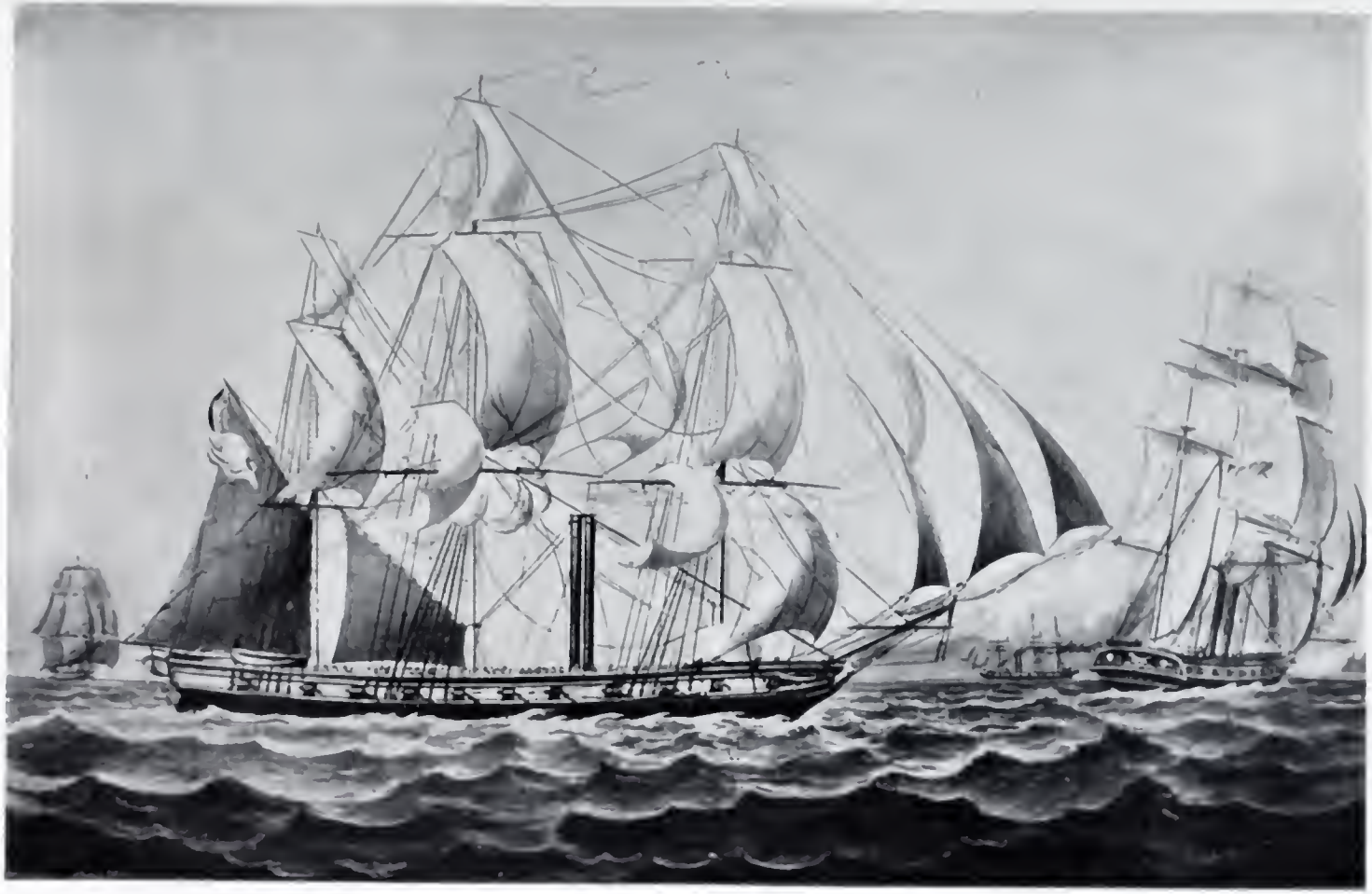
THE STEVENS BATTERY.

constantly undergoing alteration and reconstruction, she was at all times in a condition which would have admitted of her rapid completion had an emergency arisen, on the plans which were for the moment being carried out, and these plans were always so far in advance of general naval construction that if so finished she would have been a match for a fleet of the best vessels of the world at the same time. Thus, while the naval armament of the world was light, her original armour of 4½ inches would have rendered her invulnerable to the shot of an enemy, while her shell guns would have meant certain destruction to any vessel not provided, like herself, with an armour capable of keeping out such shells. As the size and penetrating power of cannon shot were increased, so was the provision for heavier armour made in the Stevens battery, and her own guns were at the same time enlarged in the successive designs." This refers to the period immediately prior to the American Civil War.

Another Stevens invention was that of the air-tight fire room, by Edwin A. Stevens, in 1842, whereby forced draught was rendered effective.

Colonel John Stevens, in 1812, designed a steam-rotated circular fort for the defence of New York Harbour, and a year or two later, his son, Edwin Stevens, under the guidance of his father, was experimenting with a 6-pounder bronze cannon against some iron plating. The elongated shell, with which the name of Stevens is always associated, was invented by Robert L. Stevens during the war between England and America in 1813–4. The shell could be fired from ordinary cannon.

"Having perfected this invention, he sold the secret to the United States after making experiments to prove their destructiveness, so decisive as to leave no doubt of the efficacy



THE "RISING STAR."

From a Picture in the Possession of the Earl of Dunfermline.

of such projectiles. One of these experiments was made at Governor's Island in the presence of officers of the army, when a target of white oak, four feet thick and bolted through and through with numerous iron fastenings, was completely destroyed by a shell weighing 200 lb., and containing 13 lb. of best Battle powder. This solid mass of wood and iron was torn asunder; the opening made being large enough, as the certificate of the officer commanding, Col. House, stated, for a man and horse to enter. These shells are free from the danger accompanying ordinary shells, for they are hermetically sealed and suffer no deterioration from time."* Some of them, indeed, were fired experimentally twenty-five years after they had been made and were found to be as effective as similar shells fired soon after they were loaded.

It cannot be said that the British Admiralty was not forewarned. Even at the time of Fulton's experiments, Lord Stanhope, who was interested in the subject, wrote to Wilberforce that "when ships of any size may be navigated so as to go without wind and even directly against both wind and waves . . . it will shortly render all the navies of the world (I mean military navies) no better than lumber." He pointed out that ships independent of wind and weather were superior to sailing ships, and that "the boasted superiority of the British navy is no more." A new navy was necessary, and the French and other nations for the same reason would have one. His lordship proved himself a true prophet so far as the other nations were concerned, for the British Admiralty was about the last to adopt steam-driven battle-ships; but as to the rest of his prophecy, Trafalgar had not then been fought.

When steam navigation came, it came to stay.

* "The Progress of the City of New York during the last Fifty Years," lecture by Charles King, President of Columbia College.

But though the Admiralty hesitated, others did not. Probably the first steam-driven ship of war which ever went to sea, though not the first mechanically propelled war vessel—the Far East, as we have seen, ante-dating us in this matter by a couple of centuries—was the *Rising Star*. She was certainly the first to traverse the waters of the Atlantic from north to south, and the first steam warship to round Cape Horn and pass into the Pacific.

The *Rising Star* was a remarkable ship in many ways. She was built at Rotherhithe for the tenth Earl of Dundonald when, as Lord Cochrane, he was engaged by the Chilian Government to create and take command of the Chilian navy, and stipulated that a steamship should be built as the best means of neutralising the difference between the Chilian and Spanish naval forces. The *Rising Star* was really taken out by Major the Hon. William Cochrane. Owing to various vexatious delays in construction, she did not reach completion in time to permit of her arrival in time to participate in the war, the energetic Admiral Cochrane having, in the meantime, disposed of the Spanish fleet with his customary thoroughness. The ship was begun at Kier's yard in 1820, and arrived at Valparaiso in April, 1822. How she was propelled is a matter of conjecture. At one stage of her career she had paddles of some sort, and also paddle-wheels, but when she finally left England a different system altogether appears to have been adopted, which seems to have been an application of the jet method, by which the ship is propelled by forcing out of streams of water through apertures in the hull below the water level.

The *Rising Star* is shown in a contemporary engraving of her to have been a full-rigged ship, without royals, and carrying, besides the ordinary square sails of her rig, peculiarly shaped square-headed staysails between the masts.

This vessel has been referred to in several books as the *Rising Sun;* it is as well that the error be corrected and her right name given. The statement that the *Rising Sun* went to Chili for Lord Cochrane in 1818 is erroneous, though often made both in this country and in America.

The Admiralty thought so little of steam engines at first that it did not trouble to record the names of its early steamers in the navy list. Owing to the representations of Marc Isambard Brunel, the Admiralty consented to try steam, and experimented with two small paddle-boats, the *Monkey*, built at Rotherhithe in 1821, and the *Comet*, built at Deptford in 1822, which were acquired to be used as tugs or despatch boats. The former was a vessel of 210 tons, and had engines of 80 nominal h.p.* by Messrs. Boulton and Watt. The two cylinders were each about 35½ inches diameter, with a stroke of 3 feet 6 inches, and, working at 26½ revolutions per minute, gave a mean piston speed of 185 feet per minute. It will be interesting and instructive to contrast these figures with those of the latest engines in warships, which will be found in another chapter. The *Active* and *Lightning* followed in 1822 and 1823 respectively, their names appearing together with a few others for the first time in the official navy list for March, 1828.† None of these steamers, however, could be classed as war vessels. From this year to 1840 seventy other steam vessels were added to the navy. All the early steamers were built in private yards, and the contractors had even to provide the engine-room staffs, which were taken over together with the steamers. By 1832, the Admiralty bestirred itself and built its first steamer, the *Salamander*, but until 1840 none was over 1,000 tons, and all were of wood, propelled by paddle

* H.P. is used here and subsequently to indicate horse-power.

† "The Marine Steam Engine," by Sennett and Oram.

engines, and such guns as some of them carried were small and ineffective. With the increase of the size of the vessels came a more than corresponding increase in the power of the engines. The *Rhadamanthus,* for instance, built in 1832, had engines capable of being worked up to 400 indicated h.p., though they were of 200 h.p. nominal. The safety valves carried a load of 4 lb. to the square inch, and the total weight of the machinery was 275 tons. In 1839, five wooden steamers were built for the Admiralty, and two of them, the *Hecla* and *Hecate,* of 817 tons, and 250 h.p. each, were sent to Scott's, at Greenock, to be engined, and were the first naval vessels to have their machinery fitted on board in Scotland.

But when men like Brunel, Scott Russell, and Laird of Birkenhead, were loudly advocating the adoption of steam-propelled war vessels, and the steamers were proving their superiority over the sailing ships in every respect, the Admiralty was compelled to pay attention. These men also urged the adoption of iron in place of wood for shipbuilding. The idea was ridiculed. It was in vain that it was pointed out that, though a piece of iron would sink and a piece of wood of the same size would float, the true test of buoyancy lay in the total weight of the material used in the construction of a hull, and that a hull of given external dimensions and built of iron would be more buoyant than a hull of the same dimensions and built of wood, and that the difference in favour of iron amounted to as much as 20 to 35 per cent.

The mere fact that iron steamers were already in existence had little influence with the Admiralty. The first of these was the *Aaron Manby,* built at Horsely in 1821, for Captain (afterwards Sir) Charles Napier and the gentleman after whom she was named. Others were doing service in Ireland. In 1832, Messrs. McGregor, Laird and Co. had the *Elburkah* con-

structed for employment on the Niger; she was 70 feet long, by 13 feet beam, and 6 feet 6 inches depth. Two years later Mr. Laird built at Birkenhead the *Garry Owen*, a little vessel only 125 feet long and fitted with two engines of a total of 90 nominal h.p. She went ashore during a gale on her maiden voyage, having as companions in misfortune several wooden vessels, and was the only one to be refloated, being little the worse for her misadventure. This proved the strength of an iron-built ship beyond doubt, and iron coasting steamers after this became comparatively numerous.

The first iron warship, a frigate, was proposed by Laird in 1836, and built at his yard at Birkenhead in 1842; it was offered during construction to the Admiralty, which would have none of it, so it was sold to the Mexican Government, which christened it the *Guadeloupe*. This vessel was 175 feet in length, by 30 feet 1 inch beam, and had a depth of hold of 16 feet.

The East India Company appreciated the value of iron steamers suitable for war purposes, and placed an order with Laird in 1839. One of those, the *Nemesis*, built under this order, went to India via the Cape, and took part in the China operations in 1840–2. She was struck several times by cannon balls and holed. Her commander, Captain Hull, reported in his evidence before the Royal Commission, in 1848, on the naval estimates, that the holes were made clean and without splinters, thus disposing of the theory that iron when struck by a shot would splinter worse than wood. Her armament consisted of two 32-pounder pivot guns so mounted as to give her a wide range of fire, and as she drew but five feet of water she may be regarded as the first of the shallow river-gunboats which have done such excellent service in so many parts of the world.

Meanwhile Francis Pettit Smith in this country had adapted

the screw propeller to steam navigation, and after one or two experimental boats had been successful, the *Archimedes,* fitted with a screw propeller of his design, made her memorable journey from port to port of the British Islands in 1838. The *Novelty,* a slightly larger vessel, of 117 feet in length, was launched the next year, both coming from the yard of Mr. Wimshurst, at Blackwall.

About this time Ericsson brought out his screw propeller, and having equipped a small steamer with it, towed the Admiralty barge a considerable distance upon the Thames with the Lords of the Admiralty on board, besides making other experiments, all of which were not without a fair measure of success. The navy officials were not convinced, however, that the application of the power at the stern was of practicable value for warships. So Ericsson went to America, and devoted his remarkable inventive genius to the welfare of his adopted country. Had he remained in England, and had his inventions been taken up by the Government, the history of the 'sixties might have been very different, for it was he who designed the *Monitor,* the small turret ship which prevented the Confederates from obtaining the command of the sea in the American Civil War.

In 1841, he accepted an order from the United States Government to furnish the designs for a screw warship, the *Princeton,* this being the first vessel which had the machinery wholly below the water-line and out of reach of an enemy's shot. This vessel is claimed by Americans to have "dictated the reconstruction of the navies of the world."* Several mechanical novelties and contrivances strange to warships, and for the most part owing the form in which they were introduced into this vessel to the fertile brain of the inventor, made

* Appleton's "Cyclopedia of American Biography."

their appearance in the *Princeton*. She had a direct-acting, semi-cylindrical steam engine of great compactness and simplicity, independent centrifugal blowers for ventilating the machinery compartment and assisting the combustion in the furnaces, so as to avoid the exposure during an engagement of the smoke stack which, as a greater measure of safety, was made on the telescopic principle. The 12-inch wrought-iron gun, with which the vessel was armed, was the first of its kind, and was at that time the largest and most powerful weapon afloat. He designed the wrought-iron gun carriages, and provided them with contrivances for dispensing with breeching and taking up the recoil. There were also an optical instrument to enable the commanding officer by mere inspection accurately to ascertain the distance of the object to be aimed at.

The Admiralty relented towards iron for shipbuilding in 1840, when it had the paddle-steamer *Dover* built at Birkenhead, and three small iron gunboats followed from the same establishment before the end of the year. The demonstration afforded by the *Garry Owen* has been alluded to. The *Great Britain*, that magnificent pioneer of the iron screw steamship, launched at Bristol, in December, 1844, ran on the rocks at Dundrum Bay on the coast of Ireland, in 1846, and was successfully refloated after being ashore for nearly eleven months, during which she withstood several severe gales. After this it was no longer possible either to ignore the superiority of iron over wood for constructional purposes, or to doubt the immense strength with which an iron ship could be built.

The enterprise and daring of Brunel in designing this ship without any data to go upon stamp this vessel as an evidence of his extraordinary genius. She was in a sense the forerunner of the *Great Eastern*, for she demonstrated what could

be done with iron; and the *Great Eastern*, constructed on the longitudinal system, though a commercial failure, proved the advantages of that system for vessels of such remarkable length, as to a large extent her design solved the problem of overcoming the sagging and hogging strains and showed the Admiralty what could be achieved in contending with this difficulty. This success helped in no slight degree to the introduction of the iron-clad citadel system some years later.

The success of the *Archimedes* and the *Great Britain* demonstrated the power of the screw, and in the latter that iron must be the material for future ship construction, whether in the navy or the mercantile marine. The Government clung to wood for all its fighting ships as long as it could, but it decided to try the screw propeller, without, however, abandoning the paddle-wheel, and many fine vessels were launched.

Before this, Messrs. Ditchburn and Mare built at Blackwall, in 1842, and Messrs. J. and G. Rennie engined, a small iron steamer of 164 tons builders' measurement, and 98 tons displacement, called the *Mermaid*. She was a screw steamer, and was fitted with George Rennie's conoidal propeller; this was a three-bladed screw propeller with the blades arranged to resemble a cone with its widest part at the boss of the propeller shaft and tapering towards the tips of the blades. The engine, having two vertical cylinders of 40 inches diameter each, and 32 inches stroke, and with a pressure of 8 lb. in the boiler, indicated 216 h.p. A spur gearing transmitted the power to the screw shaft, giving it 153 revolutions per minute and driving the vessel at its trial, in May, 1843, at a little above $10\frac{1}{2}$ knots, or over 12 miles; as the Admiralty had promised to take over the vessel if she attained a speed of 12 miles, she was accordingly purchased and under the name of H.M.S. *Dwarf* has the honour of being the first iron screw

steamer the British Government possessed. The *Dwarf* was largely used afterwards for experimenting with various kinds of screw propellers.

With the exception of the bombardment of Acre, in 1840, there was a long interval during which the world's navies were not called upon for any serious engagements, and the development of warship building which took place during that period was the result rather of scientific research than of actual fighting experience, and there was consequently no need, while the nations were recovering from the wars of the eighteenth and early nineteenth centuries, for any remarkable advances to be made. For the first fifty years of the nineteenth century the warships were much as they were in Nelson's time, except that some of them were fitted with mechanical means of propulsion.

The battle at Acre was the first in which war steamers took part, four paddle-wheel boats, the *Gorgon, Vesuvius, Stromboli* and *Phœnix,* being included in the British force. They were not of a size to do much fighting, the bulk of which devolved upon the big sailing warships, the duty of the steamers being rather to wait upon the three-deckers in the capacity of armed tugs. The engagement had little, if any, influence upon the admiralties of Europe in deciding them as to the position steam navigation should take in the fighting marine. These steamers were not the first to fire a shot in war. That honour, if honour it be, is attributed to the Canadian-built *Royal William,* which crossed the Atlantic partly under sail and partly under steam in 1833, and it is on this performance that the Canadians claim to have sent the first steamer eastward across the Atlantic. While she was lying at London she attracted the attention of the Spanish authorities by reason of her speed, and after satisfying themselves that they could depend upon her to steam

in a calm and even against the wind, they purchased her, with the consent of the Portuguese, to whom she was chartered, renamed her the *Ysabel Segunda,* gave her six guns, and used her against the Carlist revolutionaries. She was wrecked not long afterwards.

In order to test the advantages of the paddle-engine in a fighting ship, the wooden 46-gun frigate *Penelope,* which was built for a sailer, was cut in two in 1843, and lengthened to enable her to accommodate the engines and 600 tons of coal. She and about thirty or forty sister ships had been constructed on the model of the French *Hebe* class of frigates, but as they were now hopelessly outclassed by the heavier frigates introduced by other nations, this experiment was about the best use to which she could have been put. The sudden transformation of this out of date and none too powerful frigate into a vessel capable of holding her own against any vessel afloat created a tremendous sensation both in British and Continental nautical circles, and paddle-driven frigates of various sorts and sizes were introduced in the course of a few years in most of the European navies. When lengthened she was faster under sail than before, and her steam power made her independent of the wind and would have enabled her to choose her own position had she been called upon to participate in a naval engagement. Her new armament consisted of two large 10-inch pivot guns of 84 cwt. each, eight 68-pounders able to fire both shot and shell, and fourteen 32-pounders, "making a total of twenty-four guns of this immense calibre."* Her steam engines, of 625 h.p. nominal and 700 indicated, were described as of greater power than any previously placed afloat in the navy or the mercantile marine. The cylinders were of 92 inches with a length of stroke of nearly 7 feet;

* *Illustrated London News*, 1843.

the engines were of the direct acting type, such as were supplied to many other vessels of the time, and the paddles could be disconnected. Hall's patent tubular condensers were fitted, and her four tubular boilers each had five fireplaces. One peculiar feature was that the main mast was stepped between two of the boilers. The *Penelope* carried a crew of three hundred officers and men, and could accommodate a thousand soldiers with provisions and water for a voyage to the Cape. Inasmuch as her tonnage was only 1,780 tons, she must have been uncomfortably crowded, especially if the soldiers' wives and families accompanied them.

Some frigates were built to be paddle-propelled, one being the *Terrible*, twenty-one guns, which had engines of 800 h.p. The *Valorous*, the last of the type, was withdrawn in 1883.

Probably the most luxurious paddle-propelled steam frigate ever launched was the *Faid Gihaad*, whose sumptuous fittings were intended to gratify the taste for comfort, no less than the extravagant whims, of the then Pasha of Egypt. She carried on the upper deck two 84-pounder pivot guns and twelve 32-pounder broadside guns, and on the main deck fourteen guns of the latter type. Yet she was described as a yacht—of 2,200 tons. She was built by Mare and Co., of Blackwall, in 1852.

One drawback urged against all paddle-wheeled war vessels was that the deck space was seriously encroached upon, and that the paddle-boxes restricted the range of the guns. To get over this difficulty the sponsons were carried further forward and aft, before and abaft the paddle-boxes respectively, the deck-houses, which usually encumbered the sponsons, were removed, and the bulwarks were carried along the outer edge of the sponsons, thereby giving greater deck space; and as each sponson under this arrangement carried a gun, a vessel

thus fitted had four more guns than was previously possible. Two of the guns had a range extending from abeam to right ahead, and two from abeam to right astern.

One vessel thus equipped in accordance with Scott Russell's patent was the *Dantzig*, built by Robinson and Russell, at Millwall, for the Prussian navy. She was of 1,280 tons, with a deck length of 230 feet, and a draught of 15 feet ; her paddle-wheels were of 24 feet 4 inches diameter. Her dimensions, no less than the arrangement of her armament, attracted widespread attention. She distinguished herself against the Riffs in 1856.

The Admiralty ordered, in 1843, its first screw steamer, the *Rattler*, a sloop of war of 1,078 tons displacement. She had engines of 437 indicated h.p., and of the type known as Maudslay's Siamese, spur gearing increasing the revolutions of the screw to four times those of the crank. These engines derived their curious name because of their double cylinders, the arrangement having been patented some years before by Messrs. Maudslay and Field, to enable a long cylinder to be fitted in a paddle ship where the height is limited.

When there was so much difference of opinion among those passing as experts as to the respective merits of the paddle-wheel steamer and the steamer driven by a screw propeller, the Admiralty decided to settle the controversy by pitting representative vessels against each other and noting the result.

Accordingly the *Rattler* was selected to champion the screw, and the *Alecto* the paddle-wheel.

The *Alecto* was a paddle sloop, driven by direct acting engines, but otherwise was a very similar vessel to her screw rival. The two vessels were fastened stern to stern, and ordered to steam ahead. The screw steamer won the novel tug of war, the *Alecto* being towed stern foremost. This remarkable

THE TRIAL OF SCREW v. PADDLE—H.M. SLOOPS "RATTLER" AND "ALERT" TOWING STERN AND STERN.

encounter took place in the North Sea, on April 3rd, 1845, in calm weather. A more important tug of war was that on June 20th, 1849, when the screw corvette *Niger* was pitted against the paddle sloop *Basilisk* in the Channel, and again the screw boat was victorious.

The *Trident* was the first iron steamship of war ordered by the Admiralty, and the first ever built. She was launched from Messrs. Ditchburn and Mare's yard, at Blackwall, in December, 1845, and in the shape of her hull followed the lines of a sailing ship of the same size. Her length over all was 200 feet, and between the perpendiculars 180 feet; her beam was 31 feet 6 inches, and over the paddle-boxes 52 feet 6 inches, and her burthen was 900 tons. She had engines of 330 h.p., with oscillating cylinders and tubular boilers, so that altogether she was an important vessel in the constructional development of the British navy. She was very strongly put together, as her ribs were double, each rib being composed of two angle irons, 4 inches by 3½ inches by ½ inch thick, riveted together, and in one entire length from the gunwale to the keel she having a total of two hundred and seventy pairs of these double ribs. The iron skin was ¾ inch thick at the keel, and diminished to ½ inch at the gunwale. She was to carry two long swivel guns of 10-inch bore, one fore and one aft, to fire in line of keel, and four 32-pounder guns to fire on the broadside.

In 1846 the *Birkenhead* was built at Laird's yard to the order of the Admiralty as the first of a series of steam frigates, and was one of the largest iron steamers belonging to the Government. Her length between perpendiculars was 210 feet, breadth of hull 37½ feet, breadth over paddle-boxes 60½ feet, depth of hold 23 feet, and her tonnage 1,400 tons (carpenter's measurement). She was followed, in 1849, by the *Simoom*, launched by Napier, at Glasgow, and by the *Megæra*, by

Fairbairn, at Millwall, all being classed and armed as steam frigates. The *Birkenhead* was to carry a 96-pounder pivot gun aft, and a similar weapon forward, and four 68-pounders on the broadside, and it was pointed out that her round stern would add to the range of fire of the " Long Tom " aft. However, the Admiralty had serious doubts of the efficacy of these vessels, and having made some experiments with an iron ship called the *Ruby*, found that the 32-pounder gun at short range could perforate the side of the iron ship, and that the projectile carried its " cloud of langrage " with great velocity into the interior of the ship, so that men could not stand against it. These experiments resulted in the *Simoom*, *Birkenhead*, and ten smaller vessels being condemned as warships. Some of them were transformed into transports, and the Admiralty returned to its beloved wooden walls once more. The loss of the transport *Birkenhead* shortly afterwards is one of the most tragic and heroic episodes in the whole history of the British army. The Admiralty caused other tests to be made with sixteen wrought iron plates superposed, having a total thickness of 6 inches, but these also were perforated by the projectiles of the 32-pounder at 400 yards range.* The result was that the adoption of iron for the main structure of a ship was delayed until the discovery was made of the rolling of armour plates, in the time of the Crimean War, but it was not until 1859 that the Admiralty may be said to have definitely adopted rolled armour plates.

In the year 1849 Scott, Sinclair and Co. launched, at Greenock, the first steam frigate built on the Clyde for the British navy, and thus inaugurated that association between the Admiralty and the Clyde iron-ship builders which has

* " Naval Development of the Century," by Sir N. Barnaby; and " Two Centuries of Shipbuilding."

been maintained uninterruptedly from that day to this, to the marked advantage of both. The *Greenock*, for the vessel was named after the port, was 213 feet in length of keel and fore-rake, by 37 feet 4 inches beam, and was of 1,413 tons Admiralty measurement, and had engines of 565 h.p. Her machinery compartment measured 72 feet in length and contained the whole of the machinery, consisting of four rectangular boilers, fitted with brass tubes, and two steam engines, lying flat on the bottom, the whole being so arranged that all parts were several feet lower than the surface of the water The screw, which weighed 7 tons, and was 14 feet in diameter, could be detached and lifted from the water.

"The funnel also," says the *Illustrated London News* of May 12, 1849, in describing the vessel, "is to have some peculiar mode by which its hideous and crater-like physiognomy can be made at once to disappear, and leave the ship devoid at once of this unsightly feature, and of those cumbrous excrescences, paddle-boxes, giving her all the appearance and symmetry of a perfect sailing-ship."

She carried ten 32-pounder muzzle-loading guns. Her machinery is of special interest as it embodied one of the earliest attempts to drive a screw propeller by gearing. For this purpose it had four sets of massive spur wheels and pinions, in the ratio of 2.35 to 1, so that 42 revolutions of the engines per minute gave 98.7 revolutions per minute to the propeller shaft.

The engines installed in steamers, whether for war or commerce, were of the side-lever type, until they were superseded by the direct-acting type. The former was peculiarly suitable to the paddle-wheel, and in one form or another is in use to the present day. In America, the practice has been to place the beam or lever above the crank, but on this side

of the Atlantic the beam was placed below the crank. So far as warships were concerned, this method had the advantage that a great part of the machinery could be placed low down in the vessel. But the very fact that a vessel was propelled by paddle-wheels made it impossible to place the whole of the engine below the water level; it is evident that the greater the diameter of the side-wheels the greater must be the distance between the surface and the crank or shaft upon which the wheels are fastened for rotation. As increased power was required, it became necessary to add to the size and weight of the engines, which in this respect soon reached the profitable limit of their employment. Engineers were not long in foreseeing the extent of the difficulty, and, in seeking means to provide a smaller engine without loss of power, discovered a method of eliminating the lever and causing the engines to act direct upon the crank shaft. One very ingenious method by which the desired result was accomplished was that associated with the name of Mr. Penn, who introduced the oscillating cylinder in 1836. In these engines the connecting rod is done away with altogether, the piston rod works directly on the crank pin, and the cylinder is carried on trunnions which permit of the necessary oscillation, and are themselves made hollow in order that the steam may be admitted to and exhausted from the cylinders through them. The first Admiralty vessel in which they were fitted was the yacht *Black Eagle*. Another method by which great economy in space was effected was the double cylinder engine invented by Messrs. Maudslay. It consisted of two cylinders of equal size placed side by side, but with a space between them into which the foot of a T-shaped cross-head passed, the foot of the T head being connected by a connecting rod with the crank pin.

With the side-lever engines the difficulty of driving the paddle-wheels at the required speed was overcome by the introduction of the gearing wheel, and this contrivance was applied also to the engines for driving the screw propeller. As the piston speed was increased it became possible to connect the crank shaft direct to the screw shafting. The engines used for driving paddle-wheels were either inclined or vertical, but after the introduction of the screw propeller for warships, the engines were built of the horizontal type and this method remained in vogue for about thirty years. The difficulty of working in the confined space was met by Mr. Penn with the trunk engine, with which he achieved a still greater success. His equipment of the warships *Arrogant* and *Encounter* with trunk engines in 1847 so satisfied the Admiralty that engine power for driving screws could be placed so far below the water-line as practically to be safe from an enemy's shot, that altogether he applied them to no fewer than two hundred and thirty vessels, from a gun-boat requiring 20 h.p. to such ships as the *Sultan*, 8,629 h.p., and the *Neptune*, 8,800 h.p. This invention, curiously enough, helped in the retention of the sailing power, by leaving the decks unencumbered by engine houses and paddle-boxes, so that when the engines were not in use the vessels could be kept under sail only, to gladden the hearts of the adherents of the old school. It also hastened the abolition of sail, for it showed that the machinery could be placed below the water-line, and when armoured sides and protecting decks were introduced sails were dispensed with altogether.

The trunk engine remained a favourite model until it became impossible to keep the trunks in a steam-tight condition owing to the adoption of high-pressure steam. The use of a geared wheel for multiplying the number of the revolutions of the screw shaft was continued until the crank shaft could be con-

nected direct to the screw shafting. Up to about 1860 horizontal engines were the rule in warships, and though not particularly economical in the matter of fuel, they were a great improvement on the type which had been so useful for paddle engines. Surface condensation became general about 1860, and made possible the introduction of compound engines and cylindrical boilers. The old flat-sided boilers were retained when surface condensation was first introduced, but additional stays were added to enable them to stand the increased steam pressure which had by now advanced from 4 lb. to the square inch, at which it was deemed effective in the early days of the steamship, to 30 to 35 lb. to the square inch.

The warship of the "perfect sailing ship type," with the engines as little conspicuous as possible, remained in favour until the experiences of the British and French fleets in the Crimea and the Baltic compelled the abandonment of all the theories and practices which had been nursed for years; while the innovations which were made at the time of the American Civil War brought about the introduction of types of vessels which were about as unlike the historical wooden walls, the growth of centuries, as anything could well be.

Some years ago, when visiting the Brooklyn Navy Yard, the writer was discussing with the officers in charge there the effects of the war between the Northern and Southern States, and the expedients tried by the two sides, upon warship construction, irrespective of generally accepted theories and the opinions of the experts.

"Happy is the nation that has no precedents," was the sententious comment of an American officer.

CHAPTER V

IRON SHIPS OF WAR ; FROM THE INTRODUCTION OF IRON ARMOUR TO BROADSIDE AND TURRET SHIPS

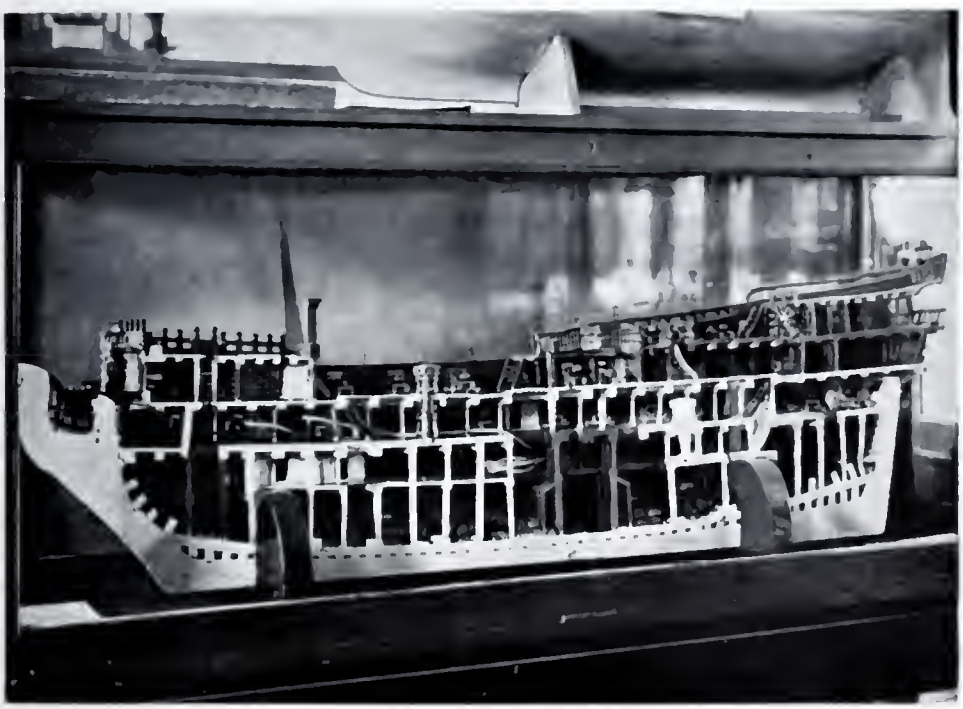
When the Crimean War broke out, Great Britain and France shared the naval leadership of the world. Nearly all the other nations had warships of one kind or another, but the finest specimens were to be found in the fleets of those two powers. They included the *Duke of Wellington*, fitted with screw engines of 700 h.p. and carrying one hundred and thirty-one guns ; the *Agamemnon*, of 600 h.p. and ninety-one guns ; and the frigate *Shannon*, of 600 h.p. and fifty-one guns, to mention three of the best examples of their classes.

Russia had some powerful vessels, including a few steam warships, but her naval resources were not equal to those of either of the allies. The French and English naval reviews in 1853 and 1854 were instructive as showing the improvements which had been effected in the preceding fifteen or twenty years. The screw propeller was so advantageous a method of propulsion that the conversion of sailing vessels into steamers went on apace in all the navies of Europe, and the United States, which usually did not at that time trouble about European naval developments, caught the infection and not only built steam frigates, but transformed some of its smaller vessels also to augment the steam warships it had already found necessary for its operations in the Mexican Gulf, the West Indies, and elsewhere. The frigate was a favourite type of ship with the Americans, and whether in the sailing days

or after the adoption of steam for warships, the American frigates were equal to those to be found anywhere.

The naval force which went to the Crimea was largely steam-driven. The Battle of Sinope, in November, 1853, in which the Russians annihilated a Turkish fleet, proved alike the superiority of a steam war fleet over a sailing fleet, and, incidentally, the range and power of the Russian guns. The Russian squadron was more powerful in every way, but its great superiority lay in its heavy artillery; all the Russian ships of the line carried smooth-bore guns which could fire shells, and the shells, exploding, set fire to and demolished the Turks in a few minutes. This demonstration of the effectiveness of the Muscovite weapons showed the allies for what they ought to be prepared when the expected war broke out; but the Russians knew that in fighting capacity their fleets were no match for the British and French fleets, so their vessels were kept under the protection of the Russian forts, and for the most part destroyed a few at a time as the war went on. The Russians are not to be blamed for shirking a naval battle, for the British and French were the greatest naval forces in the world, splendidly equipped and ready for the fray; whereas the Russians do not take kindly to naval warfare—as events half a century later showed. Many of the Russian ships were hastily equipped; it was currently reported in this country that some of them were engined with converted railway locomotives. All the Russian ships, however, were not of this type. Some were built on the Thames, among the number being the paddle frigate *Vladimir,* which gave a good account of herself in more than one engagement. She was a wooden vessel, and at the time of her construction in 1848, was considered to display a remarkable amount of symmetry of form, and to be of very considerable magnitude. Her length between

H.M.S. "CENTAUR," "BULLDOG" AND "IMPERIEUSE" ENGAGED WITH SIX RUSSIAN GUNBOATS OFF CRONSTADT, 1855.



SECTIONAL MODEL OF RUSSIAN MAN-OF-WAR, 1854, IN THE MUSEUM OF THE ROYAL UNITED SERVICE INSTITUTION.

perpendiculars was 200 feet, and her burthen 1,200 tons. She carried two 10-inch pivot guns, and four 8-inch guns mounted on sliding carriages.

The paddle frigate *Retribution*, a typical specimen of her class, launched at Chatham in 1844, was selected to proceed to Sebastopol in 1854 to demand the release of the engineers taken prisoners at the Battle of Sinope, who were in the service of the Porte. She was of about 1,641 tons and had engines on Maudslay's Siamese pattern of 400 h.p., and carried a crew of three hundred men. Her armament consisted of twenty-eight guns of a "very persuasive size"—their persuasiveness was fully demonstrated in the subsequent proceedings in the Crimea.

The naval operations before Sebastopol and Cronstadt proved by no means satisfactory to the attacking vessels. The latter were not weak as fighting ships, for they constituted the most powerful line-of-battle ships ever constructed up to that period, and nearly all of them were screw-propelled. The principal guns in the Russian forts were heavier than any carried afloat by the allies, and not only fired a heavier and more penetrating shot, but shell also—this being the first war in which modern explosive shells were used—and had an effective range far in excess of that of the ships' guns.

The great three-deckers which assailed the fortifications of Sebastopol and Cronstadt were prevented by the shallowness of the water from getting near enough to inflict serious damage irrespective of what they might themselves sustain, a course which was certainly urged, if channels could be found, especially by some strategists who, being at home, would not be exposed to the danger, and ignored the fact that the ships, if stranded, could be shelled at leisure. In the fleets' attack upon Sebastopol the sailing warships were provided with attendant steamers

lashed alongside to render them assistance when their positions had to be changed. But the range at which, for the most part, the allies' warships had to operate rendered them comparatively ineffective, and when Kinburn, like Cronstadt, proved a tougher nut to crack—a characteristic it shared with many of the Russian defences—than the allies expected, the English and French could do nothing but blockade the places and adopt other means of reducing the fortresses than by bombarding them from their big wooden battleships.

Two fresh problems had thus been created for solution. The first and most pressing was to provide the type of ship best fitted to cope with the Russian batteries. Hitherto, engagements between fortresses and battleships had been fairly equal because the guns employed by one side would be much the same as those of the other, while the ships had the further advantages of being able to shift their positions as suited them best, and to concentrate the fire of their broadsides wherever necessary. The majority of shore and battery engagements ended in victories for the ships.

The second problem was how to carry more powerful guns afloat, and how to strengthen the sides of the hulls supporting them so as to offer adequate resistance to the projectiles of equally heavy guns carried by hostile ships or discharged from the enemy's forts. The first problem was found to be comparatively easy, notwithstanding that the solution when proposed was declared by many to be impossible. It had, moreover, an important influence upon the attempted solution of the second problem. The latter was even thought to be no more difficult than the other, but the effort to grapple with it marked the beginning of the great struggle between guns and armour, and the introduction of the question of long range as against short range fighting, the end whereof is not yet.

Some little time before the war, the Emperor of the French expressed the opinion that armoured vessels of the types the Americans had devised, notably Stevens's and Ericsson's ships, were more suitable for purposes of war than the large two-deckers and three-deckers. He was confirmed in this opinion by the experiences of the big ships in the attack upon Fort Constantine, and though the opposition to his views was great, and it was pointed out that the forts must ultimately be starved into surrendering, he maintained that this would take too long and that the forts must be attacked by other means. His Majesty himself, who had devoted considerable attention to the subject, was largely responsible for the design of the five armoured French gunboats which were destined to bring about the abandonment of the great three-deckers and initiate as remarkable a revolution in warship construction as the introduction of steam was causing in naval tactics. These floating batteries—a term borrowed from the Americans—were the *Lave, Tonnante, Congreve, Foudroyant* and *Dévastation.* Their dimensions were similar: 1,400 tons displacement, 164 feet in length, 42 feet 6 inches beam, and drawing only 8 feet of water. They were built with massive wooden frames, to which were attached oaken sides 8 inches in thickness, and outside this was iron plating $4\frac{3}{8}$ inches thick. The *Tonnante,* launched at Brest in March, 1855, was the first afloat—the first iron-clad citadel ship built in Europe. After the Emperor had decided on the plans and the vessels were in course of construction, Ericsson communicated with his Majesty on the subject. He was not aware that the Emperor had already determined on the plans of the ironclads, or he would scarcely have gone to the trouble of writing, for his experience of European governments was not such as to lead him to think that they would admit he was able to teach them anything.

He is variously said to have offered to design a turret ship for the Emperor, and to have presented to the Emperor plans of a partially submerged armoured vessel with guns in a revolving shot-proof cupola placed centrally on the deck. In either case, however, he was too late. Whether he would have been called upon, had the Emperor's gunboats been unsuccessful, is a point upon which there has been much conjecture.

In designing these vessels, the Emperor had in mind that they should be cheaper and more easily and rapidly built than ships of the line, that they should draw little water, that they should be capable of being served by a small crew, and that they should be covered with an armour against which hollow shot fired from Paixhan guns "should be broken like glass," according to the *Moniteur*. Experiments made at Vincennes revealed the required strength and thickness of the defensive iron plates. The external protection was to be able to defy alike shell, solid or hollow shot, cold or red-hot shot. The Imperial designer even chose the name of the type to indicate that these vessels were not to be considered as built to pursue an enemy, but were siege batteries, capable of attacking with energy and persistence fortifications heretofore regarded as unassailable by sea.

The results of the preliminary artillery trials were communicated to the British, and trials made in England confirmed those of the French.

The British authorities, being convinced that iron-clad vessels were necessary for the reduction of the Russian forts, followed the example of the French and ordered several. These vessels were required both in the Baltic and before Sebastopol. One of these floating batteries, intended for the attack on the Cronstadt forts, was the *Terror*. Beauty was one characteristic she did not possess. She was equally bluff at the bows and

H.M.S. "WARRIOR"

Photograph by permission of the Thames Ironworks, Shipbuilding and Engineering Co., Ltd.

THE "TERROR."

By permission of Palmer's Shipbuilding and Ironworks, Ltd.

stern, and could move either end foremost to facilitate her manœuvring in an engagement. She was built, armour-plated, and launched in about three months; this rapidity of construction, as it was then considered, was due to Palmer's invention, whereby plates were rolled instead of being forged.

The English-built *Glatton* and *Trusty* differed from the other floating batteries constructed at this time, as they were pierced for sixteen guns, as against twelve for the others. As innovations they were unmercifully criticised. Their portholes, measuring 3 feet 4 inches by 4 feet 10 inches, were considered much too large. They were rigged as three-masted schooners, of all rigs in the world, with two square sails on the foremast. "Why such things as these should be completely equipped and rigged, we cannot, for the life of us, divine. The Admiralty is decidedly masting mad."*

They were 172 feet 9 inches between perpendiculars, 43 feet 8 inches extreme breadth, with 14 feet 7 inches depth of hold, and 7 feet 9 inches draught, and they were of 1,469 tons. The two decks were of oak 9 inches thick, resting on beams 10½ inches square, which were placed 21 inches apart from centre to centre, the beams being supported amidships by stanchions hinged so that they could be hung up out of the way in action. The frames, iron plates, and planking were altogether 2 feet thick on the sides. The engines were of 150 h.p., of the non-condensing type, and with four tubular, cylindrical, flat-ended boilers with two furnaces each, the pressure being 60 lb. to the inch above that of the atmosphere. Owing to their slow speed, for they could only make three knots, it was decided to give them two additional or wing screws. These batteries, according to those who had to handle them, would "neither sail, steam, stay, nor steer," and might be depended upon to affect the men's health

* *The Artizan*, Sept., 1855.

injuriously. Jury rudders had to be rigged up to get them along. All these floating batteries, whether French or English, were equally slow, and equally bad sea-boats.

The gunboats of the *Trusty* class were wooden-built and armoured; the *Erebus* class, launched in 1854–56, were iron-built.

The floating batteries were regarded with hope by those who were prepared to believe that the ironclad system would prove effective, and with undisguised contempt by the majority. What, it was asked, could these little unwieldy vessels do when the great line-of-battle ships were not equal to the task of reducing the fortifications? Still, as the Emperor had ordered them, it was but right that the experiment should be made. So when, in October, 1855, the great attack was begun, the three floating batteries which had arrived, steamed slowly into position, and came to anchor between 700 and 800 yards of the Kinburn forts. A correspondent who visited the *Dévastation* after the bombardment, "left her with the conviction that, in the attack of maritime fortresses, a new era had commenced. . . . The bulwarks had been removed from the deck, to lessen the mark, and the funnels of the steam engine alone projected. The captain conned the ship standing on the companion, and giving directions to the helmsman below; and when the vessel came to an anchor he remained below. Twelve embrasures were opened, and the effect as witnessed from the village was terrific, whilst that of the enemy's guns upon her was very slight indeed. She had three men killed and six or seven wounded through shots entering the portholes, one shell bursting inside. Not a shot from the enemy damaged the *Dévastation* in the slightest degree. She was hulled sixty or seventy times, the balls each time bounding from her sides harmless into the water, leaving their marks, it is true, in the shape of dents, in some cases an inch

and a half deep, but inflicting no real damage on plates of iron four inches in thickness. This, the first experiment, proved that at a distance of 800 yards, 32- and 18-pounders are harmless against the sides of a floating battery, and the trial has been made first by the French, the arrival of the *Meteor* and *Glatton* being delayed." When they did arrive the work for which they were intended had been accomplished. The *Dévastation* and her two sisters had platforms on stanchions near the water's edge; upon each platform were fifty French riflemen who made excellent practice upon the Russian gunners.

The Prussian Government ordered from Messrs. Robinson and Russell, in 1851, two paddle-wheel gunboats called *Nix* and *Salamander*. They were double-ended and could go either end foremost, and though they could take enough coal to carry them two thousand miles, they only drew 7 feet. Their load displacement was 468 tons, and their oscillating cylinder condensing engines gave them, together with their sails, a speed of a little over 11½ knots. The British Government exchanged the 36-gun frigate *Thetis* for them, and having renamed them *Recruit* and *Weser*, sent them to the war.

They were the only vessels of their class in the British navy. The former was employed in the operations in the Sea of Azoff, and both were held to combine the three essential features of light draught, ability to carry heavy armament, and to possess the highest known rate of speed, so as to give them the power of choosing their own time and place of attack. The *Recruit* mounted four 68-pounders on her stanchions and bombarded the Russian positions at Taganrog at 1,400 yards, in company with a French steamer, the *Mouette*.

Among the numerous types of boats, recognised as belonging to the navy or improvised for some special circumstance, few acquired during the campaign in the Baltic greater renown

than the mortar-boats, the gunboats, and the ships' boats with their rocket apparatus. In the Baltic, as in the Black Sea, the need was felt of small, shallow, powerful ships which could engage the enemy's batteries at short range, and similar batteries to those sent to the Crimea were forwarded to the Baltic also. The same difficulty of shallow water was experienced by the forces in the Sea of Azoff. So there was improvised by the officers and crew of the *Stromboli* a remarkable raft of twenty-nine casks placed in six rows and cradled in a framework of heavy spars, a portion of the upper part being planked over. The gun tackles were fastened to a spar lashed over the front of the planking, and the train tackle was similarly fixed aft. She was named the *Lady Nancy*. Her construction took twelve hours, and she carried a long 32-pounder, weighing over 2 tons, 100 rounds of ammunition, a heavy hawser, and a crew of eighteen. She gave a good account of herself at the Battle of Taganrog.

A fleet of screw gunboats, numbering nearly a hundred, and having engines of 60 h.p. each, was added to Britain's naval strength during the war. These vessels were armed with 68- and 32-pounder pivot guns and 24-pounder brass howitzers. "The possession of this force," according to a contemporary writer, "cannot be too highly estimated. No line-of-battle ship could be safe at 1,000 yards range, and, owing to their light draught of water (four and six feet), they could force their passage through the most shallow of the enemy's creeks; besides which their 68-pound shells would tell at 4,000 yards upon a ship or arsenal." Another hundred of these were all but completed, and the whole force was to take part in the great review at Spithead in 1856. "There will also," said the chronicler, "be a new description of screw-gun despatch vessels, equally elegant and powerful. These beautiful specimens

of British naval architecture have been built in the Government and private yards; they will average a speed of 16 knots an hour, and will mount five of the heaviest pivot guns. In addition to these there will be one hundred iron and wood mortar-vessels of the most powerful build, each armed with a 13-inch mortar, weighing five tons, besides half a dozen mortar-frigates (old 42's converted). To sum up, then, England is prepared with :—Line-of-battle ships, 42; heavy frigates, 56; corvettes, 123; gunboats, 220; mortar-vessels, 100; troop frigates, 10; transports, 340. And nearly the whole of this gigantic force is composed of screw or paddle-box ships, besides an immense reserve. Well may Russia be desirous of coming to terms."

After the feverish activity of the war came a period of comparative inaction. The whole political atmosphere of the world, however, was too heavily charged—too electric, as it were, to permit of hopes of lasting peace. In the United States of America the tension between the northern and southern states was already becoming acute, while in Europe the prevailing attitude of the powers towards one another was that of frigid politeness, which at any moment might thaw into hostilities. So there was no lack of incentive to continue the development of the fighting marine. The principal reasons why more was not done at this time were that naval architects and administrators were at the parting of the ways. Some urged that the types with which they were familiar should be adhered to, and that though armoured vessels were useful in the war against Russia, where peculiar conditions had to be met, it did not follow that such vessels would be of use in another war; and it was pointed out that they would be of no value whatever in a naval engagement on account of their unseaworthiness, or rather clumsiness, and the difficulty of handling them.

Others, more far-seeing, urged that iron-clad vessels were bound to come sooner or later, and sooner rather than later, since it had been demonstrated that such were not only possible but, so far as they had been used in the war, effective, and that they showed that vessels of less size, armour-plated and carrying a few heavy guns, would be more than a match for any wooden line-of-battle ship afloat. It was contended that the gunboats which silenced the Kinburn forts would be able to give a good account of themselves against the best three-deckers in the allied fleets. But the Admiralty, still convinced of the excellence of the type which had done so well in the past, retained that type and went on building wooden ships, as for that matter did all the admiralties of the world.

In 1858, there was designed the last and the finest line-of-battle ship constructed of wood for the British navy. She was launched at Portsmouth in 1859, and commissioned in 1864, and under the name of the *Victoria* served as flagship in the Mediterranean, and was removed from active service three years later. She was a screw steamer, with horizontal return-connecting-rod engines by Maudslay, indicating 4,000 h.p., and with the boilers giving 22 lb. pressure she could steam at 12 miles an hour. She carried, on her upper deck, twenty-two 32-pounders and one 68-pounder; on her main deck thirty-four 32-pounders, on her middle deck thirty-two guns of the same size, and on her lower deck thirty-two 8-inch guns. A comparison of her armament and that of the next *Victoria* shows the remarkable change made in the course of a few years in naval artillery, no less than in the arrangement of the weapons on ship board.

But whatever may have been the conservative official view, the lessons of the armour-clads in the Crimean War were not thrown away, and many naval designers were attempting to

solve the problem of the best means of applying those lessons to the altered conditions of modern naval warfare. Guns were invented, more powerful than any wooden ship could hope to withstand, and it was admitted to be impossible to place as many of them on a ship as of the ordinary weapons. The turret and the broadside systems had already been suggested, and both had their enthusiastic advocates.

The report presented by a Royal Commission appointed in 1858 to consider the relative strength of the British and French navies, first compared the state of the navies of the two powers before the Crimean War with that prevailing afterwards. In 1850 the line-of-battle ships of both countries were sailers, as were nearly all the frigates. The steam fleet of England at the time of the Crimean War was superior to that of France, which at one time had only one screw line-of-battle ship, the *Austerlitz*, available for the Baltic; but after the war the French lost little time in converting several of their sailing ships into steamships.

A return accompanying this report shows that although the British had five steam line-of-battle ships for every four possessed by France, including those completed or still under construction, the French had forty-six steam frigates to thirty-four possessed by this country. The report contained one significant item, viz., that four iron-plated ships were being built by France, and these, "appearing so ominously, had completely changed the situation."*

The French naval architect, Dupuy de Lôme, was responsible for this innovation, and the four vessels were a testimony to his genius. The first of the quartette to be launched was the *Gloire*. Originally designed as a 90-gun battleship, she took the water as a 60-gun armoured frigate. She was of 5,650 tons

* "The Encyclopædia Britannica."

displacement, and her three sisters were slightly smaller. Her armour was of iron, 4½ to 4¾ inches thick. She was not, as is sometimes asserted, armoured all over, but was plated her whole length along the water-line and for some little distance above it, and her central battery was also protected by a belt extending above the water-line belt. The engines worked up to about 4,200 h.p. indicated.

Iron armour over a wooden frame suggested a compromise in the matter of construction with which the Admiralty did not at all agree. It, therefore, decided on building an iron ship in reply to the *Gloire*, and the *Warrior* was the first sea-going ironclad. In her external appearance there was nothing to distinguish her from the average wooden steam frigate of the time, except her extraordinary length. She was a three-masted square-rigged ship, with a graceful overhanging cutwater, her dimensions being as follows: length, 380 feet, and 420 feet over all; draught, 25½ feet; depth from spar deck to keel, 41 feet 6 inches. Her engines of 1,250 h.p. nominal gave her a speed of nearly 14½ knots. She carried twenty-eight 7-inch muzzle-loading rifle guns, two other rifle guns, and two 20-pounder breech-loading rifle guns. She was built at what is now the Thames Ironworks, then the no less celebrated yard of Messrs. Ditchburn and Mare.

In describing the vessel, the builders say: "It may be of interest to note here that the *Warrior's* armour plates were all fitted at edges and butts with tongues and grooves, the tongues being formed solid out of the plate 1¼ inch wide and ½ inch deep, the grooves being formed slightly larger to facilitate entering. This plan, which was very costly, and was suggested by the curving out of the plates tested at Shoeburyness after being struck by the shot, was not repeated in later vessels, in view of the great difficulty in replacing damaged plates. It is

not generally known that the *Warrior*, though a sea-going warship, had a ram bow, the greatest projection being at about the water-line, the head knee or cutwater being brought on independently after the ram was completed, to maintain the then usual appearance of the frigates of the English navy."*

Besides the side armour, the fore and after ends of the main deck carrying the battery were protected by armoured bulkheads. The great length of the vessel rendered it impossible to armour her entirely, as had she been armoured from end to end the protection afforded to the vital parts of the ship would have been insufficient to withstand the heaviest artillery of the time. Therefore, some 85 feet at either end were left unprotected, and the weight of armour thus saved was added to that covering the central portions of the ship, so that she would be enabled to withstand the worst fire an enemy could bring to bear upon her. It was contended that were her unarmoured ends to be shot away or riddled and rendered useless, her armoured portion would remain afloat, an invulnerable citadel. The belt of armour on the broadside was 22 feet deep, and was backed by 18 inches of teak.

In every respect, save, perhaps, that of manœuvring, she was an improvement upon her French rival. Her ports were about 8 feet 6 inches from the water as compared with 5 feet 8 inches in the *Gloire*, those of the latter, though comparing favourably with the distance which prevailed in the earlier ships of the line, both sail and steam, being considered much too near the water to permit of her main deck guns being fought except in fine weather. Her gun carriages, too, were a great improvement upon anything of the kind that had been fitted in an English ship. A system of pivoting the carriages

* "Thames Ironworks' Historical Catalogue," 1905.

under the trunnions of the guns was applied, so that the guns could be trained through portholes only 2 feet wide, or half the size of those fitted in other ships, and as the sides of the ports were plated with 7-inch iron, an additional measure of protection was afforded the crew. Her tonnage was 6,177 tons, builder's measurement, but her total weight with stores and guns was about 9,000 tons.

The *Warrior* was a combination of the longitudinal system of ship construction designed by Scott Russell, and the ordinary method of transverse framing, the plans being prepared by the Admiralty. The sixth longitudinal was used to rest the backing and armour upon. The unprotected ends of the vessel were built on the transverse system, and were given a number of watertight compartments. An important feature in the construction was that the transverse plates between the longitudinals were solid but had three holes cut in them to lighten them, and it was in dealing with these plates that some of the earliest improvements were made in following ships. As a further means of giving strength, a vertical watertight longitudinal bulkhead extended from the third longitudinal on each side up to the main deck, to which it was rigidly secured, thus forming an exceedingly strong wing passage and box girder, which was further strengthened by transverse bulkheads. She had not a complete double bottom. Externally, she was fitted with two bilge keels to prevent rolling.

The *Black Prince,* which followed the *Warrior,* was 380 feet in length, and exceeded the length of the *Gloire* by 130 feet; her beam was 58 feet 4 inches, and her displacement 9,210 tons. She also was a full-rigged ship, and had an overhanging or schooner bow, the ram being thought unnecessary, as ramming was no longer looked upon as an important feature of naval tactics.

"These were the last, however, in which the essentials of pictorial beauty were held of paramount importance."*

The attitude of the Admiralty in regard to steam had hitherto been that in many respects it must be auxiliary to sail. The *Black Prince's* armour, though only 4½ inches thick, was considered to offer an adequate resistance to the 68-pounder gun's projectile, and this, too, after the experience gained in the Crimean War; besides which no allowance whatever was made for the probability that more powerful guns, firing heavier projectiles than any yet known, would shortly be in existence, especially as they were already being designed. Although called an ironclad, the *Black Prince* would be better described as "armour-patched," for only 213 feet on each side was armour-protected. The rest of the hull, including even the steering gear, was as unarmoured and unprotected as that of any sailer of a century before. The ends of the armoured belts, however, were united by iron plated bulkheads, so that the armoured portion of the ship formed a central or box battery. In order to add to the safety of the ship, in case of its penetration by a hostile shot, a number of water-tight compartments was built into her, thereby ensuring a certain amount of buoyancy. This vessel, like the *Warrior*, was "unhandy," to use a sailor's phrase, as were all her class, their length making them difficult to steer, on account of the amount of room required in which to turn. Indeed, they were so awkward that in manœuvres it was necessary to keep them four cables' lengths apart instead of the two cables' lengths customary with other vessels. The *Black Prince* carried four 9-ton guns and twenty 6½-ton guns, all muzzle-loaders. These ships were unquestionably most impressive from the spectacular point of view, and, compared with the wooden ships they

* *Times*, July 22, 1887.

superseded, their fighting value was great. They were practically the forerunners of the class represented by the three iron sisters, *Agincourt, Minotaur,* and *Northumberland.* The last named, a ship-rigged, armoured, first-class cruiser, was begun in 1865, by the Millwall Ironworks and Shipbuilding Company, and completed in 1868, the designs being prepared by the Admiralty. At first it was proposed that she should have only three masts, and as many as fifty-eight guns, but during the process of construction, it was decided to increase the number of masts to five and to reduce the number of guns to twenty-eight more powerful than those originally intended. Her design, and that of her sisters, represented a curious adherence to a belief in the necessity of sail, tempered by a desire to a compromise in the matter of more modern artillery. When launched, she had four 12-ton muzzle-loading rifle guns and twenty-two 9-ton 8-inch muzzle-loading rifles on the main deck, while on her upper deck were two 6.5-ton 7-inch breech-loading rifle guns. Her armour was $5\frac{1}{2}$ inches thick, with 9 inches of teak backing, and was extended throughout her entire length with the double purpose of protecting the ends and steering gear, and of allowing her fore and after guns to be fired from behind armour. This, of course, meant a greater weight to be carried, and it could only be done, if speed were not to be sacrificed, by increasing the length of the vessel. So far as manœuvring was concerned, these ships were much worse than their predecessors.

Their engines were on Penn's trunk system, with two cylinders of 112 inches diameter, and a stroke of 52 inches. Each had ten boilers with four furnaces per boiler, the total grate area being 956 square feet, and the steam was supplied up to a pressure of 25 lb. per square inch. These ships each carried a four-bladed Mangin propeller of 24 feet diameter,

H.M.S. "BLACK PRINCE."

Photograph by Symonds & Co., Portsmouth

THE "BANGOR," FIRST IRON SEA-GOING PROPELLER STEAMER IN THE UNITED STATES.

From a Print in the possession of, and reproduced by permission of, The Bangor Historical Society, U.S.A.

which was adjustable so that the pitch could be altered from 22½ feet to 28½ feet. The *Northumberland* was the first war vessel on which Macfarlane Gray's steam steering gear, originally invented for the *Great Eastern*, was installed. These three vessels were 400 feet 3 inches in length, and had a beam of a fraction over 59 feet, and drew 27 feet 3 inches, with a displacement of about 10,786 tons.

Before referring to the historic American ships of the third quarter of the last century, some attention may be given to a remarkable vessel which passed into the possession of the United States Government.

The steamer *Bangor* was built by the firm of Betts, Harlan and Hollingsworth (now the Harlan and Hollingsworth Corporation), in 1843–4, for the Bangor Steam Navigation Company, of Maine, and was the first iron sea-going propeller steamer constructed in the United States. The hull was formed of bar iron ribs or frames secured by numerous wrought-iron clamps, and her plating was put on in the lapped or "clinker" style, instead of the modern inside and outside method of arranging the sheets.

The *Bangor* measured 231 tons burthen; her length over all was about 131 feet; length between perpendiculars, 120 feet; beam moulded, 23 feet; and depth of hold from base line amidships, 9 feet. She had three wooden masts, with bowsprit and jib-boom, and was schooner-rigged, carrying a suit of eight sails. Passengers were carried aft in a commodious deck-house fitted up in a style of elegance unusual in those days, and considered particularly handsome by her owners and builders. There were but two deck-houses upon the vessel at the time she was built, the third or forward house, as shown in the illustration, having been added afterwards.

Her machinery consisted of independent twin-screw pro-

peller engines, having cylinders 22 inches in diameter by 24 inches stroke of piston. The propeller wheels were of the Loper type and 8½ feet in diameter. Her boiler was placed in the hold and was of iron, 20 feet in length, of the type known as the "drop flue" boiler. On her trial trip she averaged 10.61 miles per hour at one time. The first five miles were run with low steam, making forty-four revolutions. The pressure of steam was under 46 lb. to the square inch during the whole trip. Afterwards with full steam the speed per hour was 14.07 miles. From this, however, there should be deducted 2½ miles for tide, giving an actual speed of 11.57 miles per hour. On the second trip of the *Bangor* from Boston, she caught fire, and was beached upon the New England coast, near Nantucket, in order to save the crew and freight. She was afterward adjudged a wreck, the insurance settlement was effected, and she was towed to a New England shipyard (probably at Bath, Me.), where she was repaired and rebuilt. She afterwards continued to run on the same line until she was, in 1846, purchased by the United States Government, and re-named the *Scourge* at the time of the outbreak of the Mexican War. During her employ as a war vessel she was equipped with three guns. After two years of war service, she was, on October 7th, 1848, finally sold by the Government to John F. Jeter, of Lafayette, Louisiana. From the date of this transfer no trace of her can be found. It is possible that she may have been either lost by fire or storm, or have been dismantled and altered for other than her natural purposes.

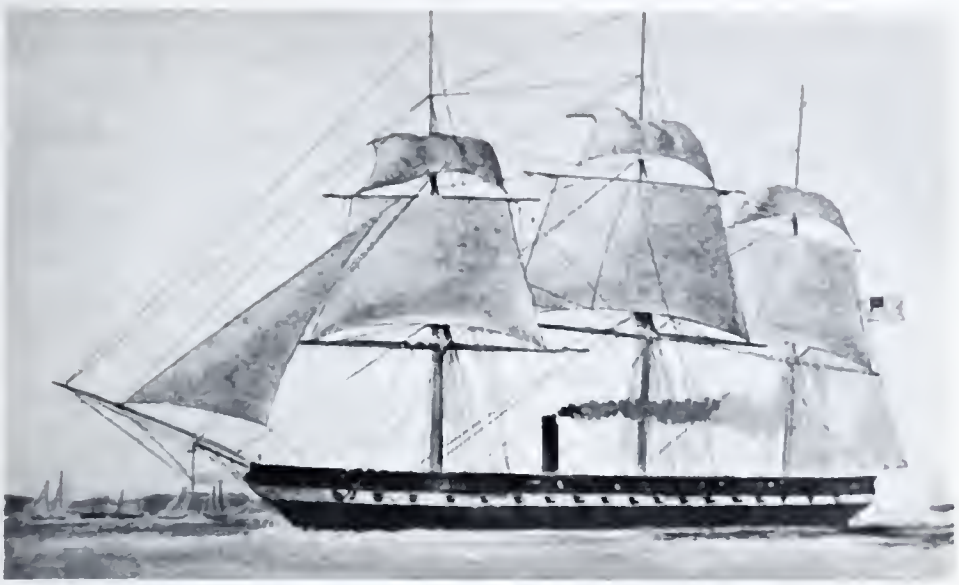
A visit was paid to England in October, 1856, on her trial cruise, by a ship which was destined to have considerable influence in the not distant future upon warship construction, and to help to revolutionise completely all the hitherto accepted theories. This was the famous *Merrimac*—the first of six

steam frigates the United States had constructed. She was considered by her designers to be a match for any vessel afloat on the European side of the Atlantic, and as a specimen of the American fondness for fast and heavily armed frigates, a type of vessel in which they excelled, she left nothing to be desired. Naturally, she attracted a great deal of attention.

The *Merrimac*—she came to England under that name, and not as the *Virginia*, as sometimes stated—was 300 feet over all, and 250 feet on the keel, and 260 feet on the load water-line, and was 51 feet 4 inches beam, and drew 28 feet of water. She was of 3,987 tons measurement, and 4,500 tons displacement. Her engines were of 600 h.p. and presented several peculiarities. The cylinders were of 72 inches diameter, with a stroke of three feet, and there were two rods to each piston. Her screw propeller was on Griffith's system, and had means of varying the pitch. Normally the screw had a pitch of 26 feet 2 inches; its diameter was 17 feet 4 inches. She had four of Martin's vertical tubular boilers. The frame of the ship was of live oak, crossed internally with two sets of diagonal iron plates, inclined in opposite directions, and similar plates on the outside strengthened her bow and stern. Her model, or shape, is said to have been of considerable beauty, while her internal arrangements for the comfort and accommodation of the officers and crew were of a high order. She could spread 56,629 feet of canvas, and nautical men here were of opinion that she could easily have borne heavier masts and spars and so have spread more canvas still. However, the weight of her armament had to be considered, and this may have been one reason why she was not more heavily equipped aloft. She was pierced for sixty guns, but on account of the weight and size and effectiveness of those she had, the number on board was only forty. Nevertheless, she was claimed to be,

and with good reason, as powerful as anything Europe could show. Two large pivot guns, of 10 inches calibre, and each weighing nearly 5½ tons, were on the upper deck, together with fourteen 8-inch guns, weighing more than three tons each ; while on the gun-deck were twenty-four 9-inch guns, each weighing close upon 4½ tons. All these guns were strong enough to fire solid shot, but they were intended to take hollow shot or shell, a custom to which the Americans attached considerable importance. The guns were built on the Dahlgren system, which gave them throughout their length a thickness proportionate to the pressure caused by the explosion of an ordinary service charge of powder. The adaptation of these guns to the Paixhan system of shell-firing was another novelty she presented. As solid shot were more destructive against fortifications and heavy works than the shells or hollow shot —uncharged shells that is—the naval experts of Europe did not look favourably upon explosive shells, preferring to consider them more suitable for large swivel guns, such as were sometimes mounted on the sponsons of paddle boats. The *Merrimac* had not a solid shot on board. Her guns were of unusual thickness at the breech and thinner than the European guns in that part called the chase, which lies between the trunnions and the muzzle. Their mounting, also, presented some peculiarities. There was no hinder truck, the force of the recoil being taken up by the friction of the carriage against the deck, but the gun recoiled sufficiently on discharge to permit of reloading ; while, instead of the hinder truck, a contrivance attached to the end of a handspike was thrust under the gun carriage. There were, in addition, a number of smaller guns.

The next that was heard of the *Merrimac* was that when the Federals found it necessary to burn certain stores and ships which could not be removed beyond reach of the Con-



THE "MERRIMAC" BEFORE CONVERSION.

THE "MERRIMAC" AS CONVERTED INTO AN IRONCLAD.

From Photographs supplied by the U.S. Navy Department.

federates after the American War began, she was one of those set on fire and then sunk. The Confederates, being short of ships—indeed, they seem to have been short of everything except enthusiasm and a belief in their cause—raised her to see what could be done with her. All her upper works had been destroyed, and her hull somewhat damaged, but she was held to be sound enough to be worth fitting out afresh. Accordingly, to meet Commander Brooke's design, she was cut down to the water-line, and given a superstructure in the shape of an ugly, squat rectangular deck-house with sloping sides, and was referred to afterwards by her northern opponents as a floating barn. The over-all deck length of this casemate was about 170 feet. Its sloping walls were framed of pine twenty inches thick, upon which oak planking four inches thick was laid, and outside this two sets of iron plates, formed by rolling out railway rails, were laid, the first horizontally and the outermost vertically. Both sets of plates were fastened on by bolts $1\frac{3}{8}$ inches thick, passing through to the back of the timber. The sides sloped considerably, according to some writers 35 degrees, while others put the inclination at 45 degrees. The intention was that any shot striking her should only inflict a glancing blow and ricochet harmlessly. For the same reason the ends of the casemate were given a similar angle, but instead of being straight like the sides, were semi-circular, or almost so. The top of the structure was covered by an iron grating, which served the double purpose of permitting the ventilation of the interior and keeping out missiles. This grating measured about 20 feet by 120 feet. Her armament consisted of two 7-inch rifle guns mounted on pivots so that they could be fired through any of the ports in the sides of the casemate, a 6-inch rifled gun on either broadside, and three 9-inch smooth-bore Dahlgren guns. Altogether she had fourteen gunports. To

add to her effectiveness, an iron ram was affixed to the bow. Her stern lay very little above the water, but the highest point of the bow was about two feet above the sea. Her conning tower, a cone three feet high and protected by four inches of armour, was placed beyond the forward end of the casemate. Her funnel was unprotected. Though supposed to be renamed the *Virginia*, she never lost her old name of *Merrimac*.

Against the wooden ships in Hampton Roads she was invulnerable. Even at point-blank range their broadsides did not suffice to stop her. This was her trial trip, and her engines, patched up after their experiences in the fire and at the bottom of the harbour, could only get her along at about four miles an hour, and her crew had never been afloat in her before. Nevertheless her commander, Franklin Buchanan, combined the trial trip with active service, and attacked the northern ships with a determination which carried consternation to the North. The wooden *Cumberland* was blown up and the *Congress* sunk, the latter as the result of an application of the ram, which, however, injured the ramming vessel so much that the future effectiveness of her ram was greatly reduced. Buchanan was so badly wounded in this engagement that he was unable to command the *Merrimac* in her duel the next day with the *Monitor*.

The *Monitor*, designed by Ericsson, was built under very arbitrary conditions. When it became known that the *Merrimac* was under construction, President Lincoln advertised for something to meet her on equal terms, and Ericsson tendered. He pointed out that the armour plates of the *Gloire* or *Warrior* would be useless against the heavy 12-inch wrought-iron gun he had brought out in 1840, in connection with Colonel Robert Stockton, and as he pledged himself that he could complete in a hundred days a steam vessel carrying two of such guns placed in a turret which should be armour-plated and proof

against the heaviest guns the Confederates could place in the *Merrimac*, his tender was accepted. Ericsson was hampered in his work by the interference of the government officials, hardly any of whom understood his plans, but all of whom thought themselves competent to improve upon them. Considering the limitations under which his undertaking had to be accomplished, the *Monitor* was a remarkable vessel in every respect. He had to draw out his plans to scale, have all the parts designed, see that everything was made as he designed it, and supervise the construction of the ship and engines, and the whole of this work had to be done within a stated time. The adventure, for such it unquestionably was, was hailed throughout the length and breadth of America as the work of a madman. Like all innovations destined to play an important part in the world's history, it was greeted with derision and abuse. There were a few people on both sides of the Atlantic who recognised the importance of the change in naval construction which Ericsson's ship inaugurated. These were they who had profited by the lessons of the armoured gunboats or floating batteries employed by the French and English in the Crimean War. They saw that if small but powerfully armed ships could effectively attack powerful shore batteries, and by reason of their shape could never receive a direct blow but only glancing shots, a vessel carrying a circular fort which also could not receive a direct blow must be superior to any vessel afloat, especially if its fort or turret were so heavily armoured as to be proof against the heaviest ordnance to whose fire it should be subjected. Moreover, if the hull were made to offer the least possible mark to an enemy, the difficulty of striking the vessel to sink it would be greatly increased. The form of the vessel was such that if it were used as a ram the weight behind the ram would be in a horizontal

plane with the ram at the point of contact, and greater injury would thereby be inflicted upon the side of an opposing vessel than were there a greater amount of weight above the horizontal plane.

These considerations were ably supported by Admiral Porter, of the United States Navy, who was well aware of the value of such a means of attack even if the propelling engines could not give the ship a speed of more than four or five miles an hour. The gallant admiral himself was the butt of no slight amount of ridicule by his emphatic declaration that the *Monitor* "is the strongest floating vessel in the world and can whip anything afloat." The vessel was built of iron, and can best be described as a shallow, oblong box, with sloping sides, having upon it a pointed, flat, shallow box or raft with a stumpy, circular tower or turret amidships. This box or upper part projected a considerable distance all round above the lower part, and especially so at the stern; and had not the whole vessel been very strongly constructed, the fearful blows which the under-part of the projection received from the sea as it rose and fell on the waves on its passage from New York to Hampton Roads would have driven the two parts asunder.

Up to the last Ericsson was bothered by the government officials. Had he been left to himself the ship would not have had such a narrow escape from going to the bottom. They interfered with the turret-bearings, with the result that when the sea washed over the low deck, the water poured into the hold from all round the turret and put out the fires in the engine room, when the fumes drove the engineers out of their quarters and nearly poisoned everybody in the turret through which all the outgoing ventilation had to be made. However, the tugs got the vessel safely into smoother water, the furnace

THE "MONITOR"-"MERRIMAC" DUEL.

From a Photograph of a Contemporary Drawing supplied by the U.S. Navy Department.

was set going again, and the pumps were restarted, and by the time Hampton Roads was reached the vessel was labouring along as best it could under its own steam and with the aid of a couple of tugs. The narrow escape the *Monitor* had from foundering on this voyage served to stimulate the chorus of disapproval, and there were not wanting many on the northern side as well as on that of the south to predict the failure of "Ericsson's folly."

Ericsson had confidence in his ship. He had never forgiven the British Admiralty for its rejection of the screw propeller, nor for ignoring his suggestions in regard to the *Princeton*, and one reason why he chose the name of the *Monitor*, as he told the writer and others more than once, was that it should be a perpetual reminder to the British Admiralty of the chance it had lost.

In the turret were two 11-inch Dahlgren smooth-bores which fired solid iron shots weighing 135 to 136 lb. each with charges of 15 lb. of powder, and were even more powerful than his own gun. Solid iron stoppers closed the ports when the guns were run in. The deck had five projections besides the turret. Right forward was a small square pilot-house measuring four feet, and constructed of bars of iron nine inches thick, and provided with a flat iron roof two inches thick. In the sides of the pilot-house were narrow slits as sight holes. The other projections were two small chimneys six feet high, removable before an engagement, and two intake ventilators.

Neither side on the morrow shirked the coming duel. From the outset the *Monitor* was the better prepared. Her guns fired solid shot; the *Merrimac* had only shell and grape, neither of which was calculated to do much harm to the *Monitor's* turret, whereas the blow of the *Monitor's* shot upon the sloping sides of the *Merrimac's* battery was bound to be delivered with

terrific force, even though the blows were slanting. For another thing, the southern vessel was built of wood and had already suffered severely in the hard contest at short range with the battleships the previous afternoon; her engines were shaky, and her steering gear worked worse than before; and the experiences of some of her crew, coupled with the wounding of her commander, had not been such as to leave their confidence unshaken. The *Merrimac* was now commanded by Commodore Tatnall, the hero of the episode in the Anglo-American attack some years before upon the Chinese forts at Peiho, when he justified the participation of the Americans by the famous remark that "blood is thicker than water." Tatnall proved himself a worthy successor to Buchanan.

When the *Merrimac* sallied forth the next morning intending to complete the destruction of the northern warships, she found the *Monitor* waiting for her. Notwithstanding the inferiority of his ammunition, Tatnall never hesitated for a moment. The firing between the two ships was mostly at short range, and by the time the battle was over both vessels had had enough of it. Neither side admitted defeat, but neither side had succeeded in destroying the other. The *Monitor* was struck twenty-two times, and in return she fired forty-one shots. Precisely how many of these were effective on the southern ship is not known, but including the fight of the previous day, she was found afterwards to have no fewer than ninety-seven indentations on her armour. Her layers of plating were shattered, and the heavy wooden backing was splintered, but not one of the heavy shots of the *Monitor* succeeded in penetrating the *Merrimac*. The backing only splintered where the heavy shot had struck direct blows. Nine of the Confederate shells struck the turret, and the pilot-house was struck twice, and the other projections and the deck also

showed marks of the enemy's fire. The result of the battle was that the *Monitor* was able to resume hostilities and the *Merrimac* was so badly crippled that she could not do so.

The steering gear and anchor of the *Monitor* were protected by the overhanging deck, and were out of reach of the *Merrimac's* fire. This arrangement was repeated with modifications in most of the northern monitors afterwards built, and greatly puzzled the Confederates until they discovered the method by which the vessels could be anchored or lift anchor without anyone appearing on deck.

It should be remembered that the *Merrimac* had to contend not only against the *Monitor*, but also against the gunboats of the northern fleet, which fired upon her whenever they had a chance.

The subsequent fate of these two typical ironclads is interesting. The *Monitor* was sent to sea in weather she could never hope to contend against, and went to the bottom. When the fortunes of war drove the Confederates away from the positions they had occupied at Hampton Roads, the *Merrimac* was scuttled by her commander to prevent her falling into the hands of the Federals. Both sides went on building ironclads of the types they had introduced. The Federals rapidly acquired a fleet of monitors, because they were convinced of the superiority of that type of vessel, and had almost unlimited resources. The South built a few more broadside ironclads because it had no option in the matter. It was a case of taking wooden steamers and plating them as best it could with rolled-out railway metals, boiler plates, and, in fact, anything metallic that could be bolted on.

The *Atlanta*, formerly the English steamer *Fingal*, was cut down much as the *Merrimac* had been, and given a heavy wooden casemate plated with iron. The two monitors, *Nahant*

and *Weehawken,* were waiting for her, and when she set out from Savannah to look for them, they followed. So also did some steamers carrying a large number of Southerners who went to see their ship defeat the monitors. The *Atlanta* fired one shot at the *Weehawken* and missed, and the monitor returned the compliment by steaming to within 300 yards and firing her heavy 15-inch gun. The projectile smashed the *Atlanta's* armour and wooden backing, and the flying splinters wounded sixteen of the crew. She returned the fire two or three times without hitting once, but the *Weehawken's* second shot smashed the pilot-house and the third started the casemate from the deck. The *Atlanta* surrendered in fifteen minutes after the firing of the first shot. Her subsequent employment was as a guardship in the northern fleet. The *Nahant* did not fire.

The *Albemarle,* another Confederate ram of the *Merrimac* type, had a short but exciting career. She carried only two 100-pounder rifled guns, pivoted to fire end-on or on the broadside. Her first exploit was to ram the northern gunboat *Southfield,* in the Albemarle Sound; her ram entered about 10 feet, and the *Southfield* began to sink so rapidly that, before she rolled off the *Albemarle's* ram, she nearly took the latter down with her. The *Albemarle* afterwards fought a pitched battle with four northern paddle-wheel gunboats, and although she was rammed and damaged, she held her own. Her destruction may be said to have heralded the introduction of the torpedo boat, and for this reason is referred to in a subsequent chapter.

Another most notable example in these improvised ironclads was the ram *Tennessee,* which was designed and commanded by Commodore Tatnall. This vessel played a conspicuous part in the defence of Mobile against the Federal fleet under Admiral Farragut, in August, 1864. The *Tennessee* was admirably designed for the purpose intended, which was

THE "MONITOR" AND "ALBEMARLE"

From a Painting, by Meeker.

FEDERAL GUNBOAT "ST. LOUIS."

From Photographs supplied by the U.S. Navy Department.

that of an ironclad, heavily armed, and able to ram; but unfortunately for her, she could not be got completely ready in time, nor was it possible to give her the armoured protection or the weighty artillery which had been contemplated at first; nevertheless, her commander fought her well, and that she came absolutely to grief was due to hasty construction and lack of material to put into her, rather than to any fault in the design of the ship itself. Her battle with the Union fleet shows with what grim determination the ship was fought.

"There was a brush with the ironclad ram," says an American writer, "but it was not serious, and the fleet came to anchor three miles up the bay. Farragut was planning to attack the ram as soon as it should be dark enough to prevent the garrison seeing which was friend and which foe; but the ram anticipated him and steamed direct for the flagship (the *Hartford*) in the midst of the fleet. The Admiral at once gave orders for every ship to attack her, not only with shot but by ramming, and a desperate contest ensued. The ram had the advantage in that she was sure of striking an enemy with every blow, while the fleet had to avoid running and firing into one another. Their shot had no effect on the sloping iron sides of the monster, and when the wooden vessels rammed her they only splintered their own bows and only heeled her over. But the monitors, with their enormous guns, shot away her smoke-stack and steering apparatus, and jammed her shutters, while one 15-inch shell actually penetrated her armour."*

This heavy cannonade proved too much for her. With her armour battered, her machinery damaged, her commander badly wounded, her steering gear disabled, she lay helpless at the mercy of her foes and surrendered.

Another type of ironclad which the Confederates employed

* Appleton's "Cyclopedia of American Biography."

was known as the *David,* because though small it was hoped it would deal as effectively with the big northern warships as its Hebrew namesake had dealt with Goliath of old. The parallel, however, ceases with the name. The first American *David* was tried at Charleston, in October, 1863. She was cigar-shaped, 54 feet long, and 6 feet in diameter, and carried a small steam engine to drive a small screw propeller. Her one weapon was a spar torpedo, and when she had exploded it she was expected to go to the bottom with such of her crew as did not happen to be able to save themselves.

Many brave deeds have been done in war by combatants and non-combatants alike, but the cool courage of the pilot or steersman of the first *David* will take some beating. Her initial attack was directed against the ironclad ship *Ironsides,* named in commemoration of the " Old Ironsides," and whether failure or success attended the attempted destruction of the ship, those on the *David* knew they were engaged in a forlorn hope. Only the funnel and pilot-house of the little vessel were discernible above the sea level, and even they were not very conspicuous. The *David* was hailed, and replied with a volley of musketry, and an instant later a torpedo exploded against the sides of the warship. It lifted her and shook her, but inflicted no material damage worth speaking of, but the moral effect was considerable, as the Federals knew the Confederates had now devised a new means of attacking them. At the moment of the explosion the four or five men composing the crew of the *David* jumped overboard, as it was thought she would be swamped by the backwash of the explosion. She did not sink, however, and the pilot held on to her for his life, for he was the only man on board who could not swim. The engineer swam to her, and together they took her back to Charleston.

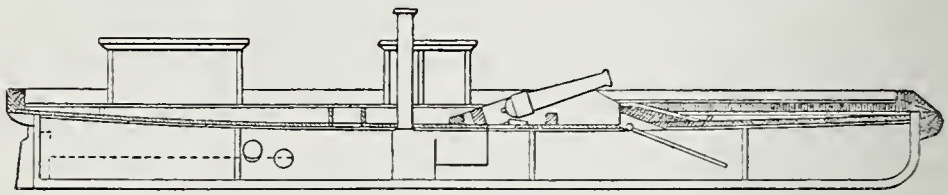
On the Mississippi and the other American rivers both sides improvised as gunboats anything that had an engine in it and a platform upon which a gun could be carried. Small tug-boats were given turtle-back armour, too thin to be of use, whence some of them got the name of tin-clads in contradistinction to the ironclads; big side-wheel steamers were protected with anything that could be utilised for the purpose, from logs to bags of ashes, and ordinary river cargo steamers and barges were also found very adaptable. It may, indeed, be doubted if in any war there has been such an assemblage of opposing warships improvised from the most unpromising materials as in the American Civil War. The majority of them were not of great use as combatants, notwithstanding that their crews usually handled them with reckless bravery, and after the passage of the Mississippi mouth had been forced and the northern warships were able to ascend the river, the fighting value of these makeshifts became almost a negative quantity. In the absence of superior force, however, there was no telling what they might attempt, for their crews were as reckless as they were daring.

When the Civil War began, Edwin Stevens offered the Federal Government, at his own expense, a small vessel called the *Naugatuck*. This was a twin-screw vessel, which could be immersed two feet below her load-line and raised again in eight minutes by pumping out the water admitted into the tanks. The solitary gun was mounted on a revolving carriage, and the recoil taken by rubber disc springs. It was loaded, directed and fired from below the deck, the loading being accomplished by bringing the depressed gun opposite a hole in the deck, provided for the purpose.* She carried a Parrott gun, a 100-pounder, and was one of the fleet that attacked the *Merrimac*.

* *Engineering*, March 26, 1897.

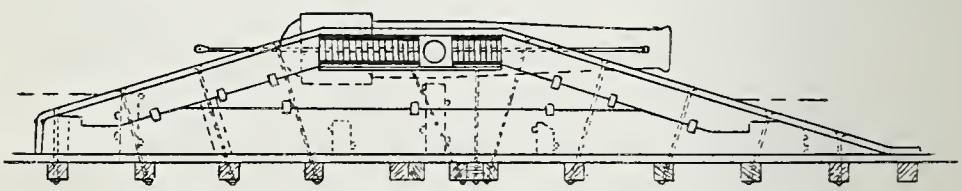
Her twin screws enabled her to turn from end to end in seventy-five seconds. She did good service on the James River, until her gun burst; her crew, thanks to her protecting deck, escaping injury. This vessel is chiefly of interest because of the method of placing and loading the gun.

Ericsson's inventive genius was responsible in 1861, before



THE *NAUGATUCK.*

the war broke out, for a vessel of 3,033 tons, which he named the *Dictator,* but she was not launched until 1863, the builders being the Delamater Iron Works. She was an iron-framed vessel, and had a wooden skin 3½ feet thick. The iron protecting her sides was 11 inches thick, 5 inches of which were solid bars measuring 3 inches by 5 inches, and the other portion



THE GUN-CARRIAGE OF THE *NAUGATUCK.*

was built up in single 1-inch plates. Her ram, a heavy structure of oak and iron, projected 22 feet beyond the bow. On deck she carried a single turret with an inside diameter of 24 feet. The walls of the turret were protected by 15 inches of iron plates, each 1 inch in thickness, and weighed 500 tons. Her engine was of Ericsson's vibrating lever type with two cylinders 100 inches in diameter, and indicating

5,000 h.p. The screw was 21 feet 6 inches in diameter, with a pitch of 34 feet, and was cast in one piece, its weight being 17⅔ tons. The *Dictator's* armament was two smooth-bore 15-inch guns, known as Ericsson guns, which were of the same type as he introduced into America on behalf of Col. Stockton, and with a charge of 80 lb. of powder, threw a round shot weighing 460 lb. The ship was 320 feet long, 50 feet broad, and drew 22 feet of water.

In the subsequent monitors the conning tower was placed above the turret as in the case of the *Passaic*. Monitors were built later with two turrets, and a flying deck connected them. They were of much greater dimensions than the single turret ships, and carried twice the number of guns, and being considerably heavier and faster and more extensively armoured, were exceedingly capable fighting machines.

But the wooden warships were not destined to pass away without making a gallant struggle well worthy of the traditions of centuries. The last great battles in which they engaged were at New Orleans and Mobile, and well they acquitted themselves. Stranded, rammed, and almost set on fire, as they were time after time, they yet carried on an unequal contest until they achieved splendid victories at these places. Not even torpedoes, as mines were then called, daunted Admiral Farragut, who, at Mobile, when a ship that was leading hesitated and nearly threw the whole line into disorder, inquired, "What is the matter?"

"Torpedoes," was the answer.

"Damn the torpedoes," roared Farragut from his usual place in the rigging, to which he was accustomed to mount in order to see over the smoke. Whereupon his ship, the *Hartford*, assumed the lead.

On the Atlantic coast the South endeavoured to maintain

its unequal contest by means of blockade runners and privateers. Foremost among these were the *Shenandoah,* which has the distinction of being the only ship to carry the Confederate flag round the world ; the *Sumter,* a small commerce destroyer, commanded by Captain Raphael Semmes, who afterwards had the *Alabama ;* and the last-named herself. The *Sumter* was described by Captain Semmes as a " stone which had been rejected of the builders," and he says that he endeavoured to work it into the building which the Confederates were then rearing. " The vessel was reported to him as a small propeller steamer of 500 tons burden, sea-going, with a low-pressure engine, sound, and capable of being so strengthened as to be enabled to carry an ordinary battery of four or five guns. Her speed was reported to be between nine and ten knots, but unfortunately, said the Board, she carried but five days' fuel, and has no accommodation for the crew of a ship of war. She was, accordingly, condemned. When I finished reading the report, I turned to the Secretary and said, ' Give me that ship ; I think I can make her answer the purpose.' My request was at once acceded to ; the Secretary telegraphed to the Board to receive the ship, and the clerks of the Department were set at work to hunt up the necessary officers to accompany me, and make out the proper orders. And this is the way in which the Confederate States' steamer *Sumter,* which was to have the honour of being the first ship of war to throw the new Confederate flag to the breeze, was commissioned."

He got her into shape somehow, and she began her adventurous career by running the blockade in a most daring fashion at Pass a l'Outre, in spite of the presence of the *Brooklyn,* which was faster and more heavily armed. She beat the northern ship simply because she could sail nearer to the wind. After six months' experience of this ship, he says that " in

her best days the *Sumter* had been very inefficient, being always anchored, as it were, in the deep sea, by her propeller whenever she was out of coal. A fast ship propelled entirely by sail power would have been better." She captured seventeen ships, consistently dodged five or six northern ships, and at last had to be laid up at Gibraltar. She afterwards sailed as the *Gibraltar* under the English flag as a merchant vessel, and made one successful voyage as a blockade runner to Charleston, South Carolina, and went to the bottom of the North Sea soon afterwards.

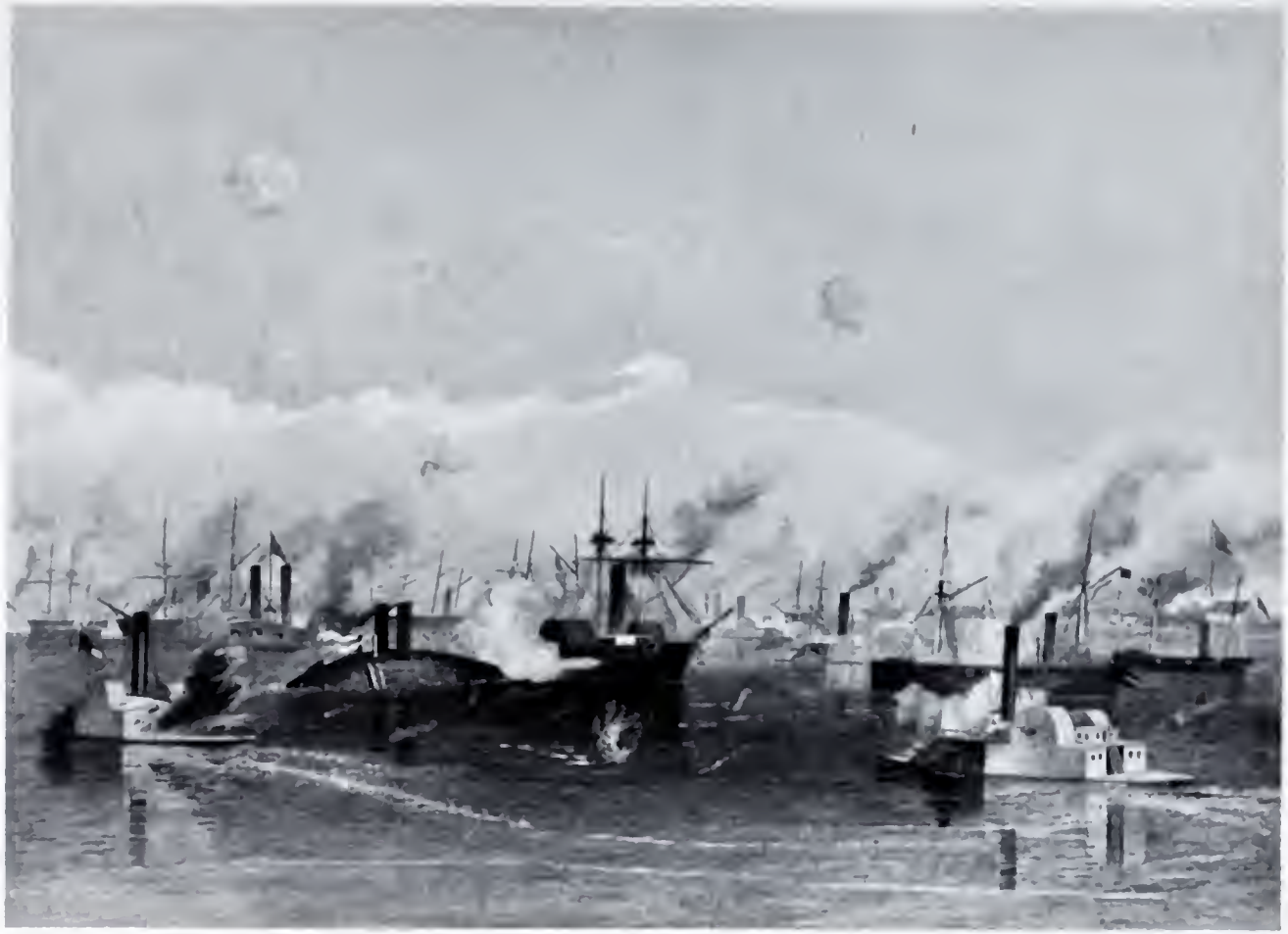
The *Sumter's* battery consisted of an 8-inch shell gun pivoted amidships and four 32-pounders of 13 cwt. each for broadside firing. The slide and circle for the pivot gun were constructed of railway iron. She captured seven prizes in two days, and escorted six of them into the harbour of Cienfuegos at once.

The *Alabama* was built at Birkenhead under a contract with the Confederate States, and was paid for out of the Confederate treasury. "The *Alabama* had been built in perfect good faith by the Lairds. When she was contracted for, no question had been raised as to the right of a neutral to build and sell to a belligerent such a ship."* Be that as it may, the settlement of the *Alabama* claims proved an expensive item for Great Britain. She was responsible for the destruction of no fewer than sixty-seven American ships, and such was the terror she inspired that the armed frigate *Kearsarge* was sent to hunt her down and exterminate her. Soon after embarking on her privateering, the *Alabama* fought and sank the *Hatteras* in the only engagement she was concerned in until she met her fate at the guns of the *Kearsarge*. There was not much to choose between the ships in size, but in all other respects the advantage

* "Service Afloat," by Raphael Semmes.

lay with the northern ship, which had further strengthened her sides with a concealed belt of chain cables.

"As for the ships," writes Captain Semmes in "Service Afloat," "though the enemy was superior to me, both in size, staunchness of construction, and armament, they were of force so nearly equal, that I cannot be charged with rashness in having offered battle. The *Kearsarge* mounted seven guns—two 11-inch Dahlgrens, four 32-pounders, and a rifled 28-pounder. The *Alabama* mounted eight—one 8-inch, one rifled 100-pounder, and six 32-pounders. Though the *Alabama* carried one gun more than her antagonist, it is seen that the battery of the latter enabled her to throw more metal at a broadside, there being a difference of three inches in the bore of the shell-guns of the two ships. Still the disparity was not so great but that I might hope to beat my enemy in a fair fight. But he did not show me a fair fight, for, as it afterwards turned out, his ship was iron-clad. It was the same thing as if two men were to go out to fight a duel and one of them, unknown to the other, were to put a shirt of mail under his outer garment. . . . By Captain Winslow's own account, the *Kearsarge* was struck twenty-eight times; but his ship being armoured, of course, my shot and shell, except in so far as fragments of the latter may have damaged his spars and rigging, fell harmless into the sea. The *Alabama* was not mortally wounded until after the *Kearsarge* had been firing at her an hour and ten minutes. In the meantime, in spite of the armour of the *Kearsarge*, I had mortally wounded that ship in the first thirty minutes of the engagement. I say 'mortally wounded her,' because the wound would have proved fatal but for the defect of my ammunition. I lodged a rifled percussion shell near her stern-post—where there were no chains—which failed to explode because of the defect of the cap. If the cap had performed



CAPTURE OF NEW ORLEANS—ATTACK ON FORT PHILIP.

From a Contemporary Steel Engraving, showing unprovided warships [illegible]

its duty and exploded the shell, I should have been called upon to save Captain Winslow's crew from drowning, instead of him being called upon to save mine. On so slight an incident—the defect of a percussion cap—did the battle hinge. The enemy was proud of this shell. It was the only trophy they had ever got from the *Alabama*. We fought her until she would no longer swim, and then we gave her to the waves."

The *Shenandoah* was the name given by the Confederates to the Glasgow-built auxiliary steamer *Sea-Horse*, which was the only ship to carry the southern flag from Dixie's Land to the Cape, thence to Australia, and up to the North Pacific. She found her chief prey among the American whalers.

CHAPTER VI

IRON SHIPS OF WAR—*continued*

THE Admiralties, naval architects, and a great many other people throughout the world were troubled for several years through trying to reconcile all the divergent and often contradictory claims put forward as to what should constitute a fighting ship. Those who troubled most were those who knew least of the subject. The naval architects, having to make the necessary calculations, were not without some knowledge of the limitations of the materials at their disposal; and the Admiralties left matters to the experts, whether employed by Governments or in private shipbuilding establishments, confident that those who were best acquainted with such a technical subject would be most likely to set forth something possible of attainment and destined to show certain definite results. And this has been the attitude of all Governments towards all inventors, whether their inventions were of practical utility or were merely the outcome of seeing visions and dreaming dreams. This does not imply, however, acceptance of the official theory that Government experts know everything.

Many people, after the American war, went turret-mad, and became possessed of the idea that this country should own a numerous fleet of monitors, so numerous, indeed, that every port all round the British coasts should have two or three of such vessels in order that an enemy's fleet, usually conjectured by the turret enthusiasts to consist of large two or three-decked battleships, should be met by a succession

of monitors each manned by a fresh crew and full of ammunition, and reduced to submission if possible, or sunk, or scattered as was the Spanish Armada, an historical allusion which these good people found very useful as adding a picturesque touch. Nor were the enthusiasts of other countries behind those of Great Britain in their advocacy of their pet theories. Naval economists, who yet wished to swim with the current of naval enthusiasm, did not hesitate to point out the economy of construction to be effected by a fleet of monitors or of small vessels carrying turrets. Some contended that no guns were too heavy to be sent afloat, so that they should smash any armour by the weight of their projectiles; and ingenious were the calculations to demonstrate how easy it would be for a heavy gun, such as was used for land fortifications, to be sent to demolish a hostile vessel whatever her dimensions and armament. Others clamoured for the heaviest possible armour, even if only moderately powerful artillery should be installed, coupled with great ramming power. That every part of the ship should be so heavily armoured as to be invulnerable was another contention which found much favour, its adherents forgetting that too much armour would sink the vessel; but its opponents rejected it in favour of the concentration of the armour over the vital parts of the ships, and leaving the ends unprotected or nearly so. Other claims were for high speed, great coal capacity, large sail power, lofty freeboards, seaworthiness, steadiness of gun platform, small size, shallow draught, and comparative invisibility to an enemy's gunners.*

As it was manifestly impossible to build ships which should meet the requirements of all the nation's advisers and be suitable to be sent to perform all kinds of duties anywhere, armoured ships began to be constructed of special types accord-

* "The Royal Navy," by Sir W. Laird Clowes.

ing to the work expected of them. The first division was into battleships, armoured cruisers, and coast defence ships.

As the result of Captain Coles's advocacy of the turret system, which he began in 1861, the Admiralty, when converting a number of old and new wooden ships into ironclads, had one of them, the *Royal Sovereign*, cut down, covered with armour, and given four armoured revolving turrets placed on the upper deck in the middle line of the ship. She marked the conversion of the Admiralty to the new order of things which steam power and iron armour in combination had rendered possible. One step in the process of conversion was that sail power was no longer considered necessary in fighting vessels, another was that the combatant part of every ship intended for heavy fighting should be afforded as much protection as possible, and a third step was that the guns should be few in number, of considerable power, and so disposed as to have the widest possible range. This ship could fire all her guns on either broadside, and also had a direct fire ahead and astern. She started her career as a 131-gun line-of-battle ship, but after her alterations she carried five 12-ton muzzle-loading guns, of which two were in the foremost turret and one each in the others. She was also the first of the converted vessels to be given a steel protective deck, in her case two inches thick, but it was not curved so as to place the edges below the water-line, and it consequently would not have afforded any protection to the vessel had a shot penetrated the armour at the water-line. Her low freeboard would have rendered her difficult to hit, and she would have been able to approach an enemy and deliver a telling fire at comparatively short range without running undue risk of receiving much damage in return.

The dimensions of the first British turret ship compare curiously with those turret ships which followed her in rapid

THE "PRINCE ALBERT" (SISTER SHIP TO THE "ROYAL SOVEREIGN") AS CONVERTED TO A TURRET SHIP.

From the Model in the Royal Naval [illegible]

H.M.S. "MINOTAUR."

Photograph by Symonds [illegible], Portsmouth.

succession, both in the British and other navies. She was 240 feet 7 inches in length, with an extreme beam of 62 feet and a draught aft of 24 feet 11 inches.

Even after the launch of the *Warrior* the Admiralty ordered a few wooden ships, but in 1866 decided upon the adoption of iron warships. One of the last and certainly one of the best to look at of the wooden armour-plated ships was the steam frigate *Lord Clyde*, but as a sailer she had many defects, of which slowness was not the least. In her case the armour extended to the ends of the ship, and nowhere was it less than 4½ inches in thickness, while at the water-line the armour plates were 5½ inches thick. The sides of the entire battery deck from stem to stern, and from 3 feet below to 3 feet above the ports, were plated with 6-inch armour, of which one thickness of 1½ inches was bolted to the ship's frame, and the other, of 4½ inches, was placed upon the outside of the planking. The armour went 6 feet below the water-line amidships, and for the sake of lightness was only 4½ feet deep at the ends. The gun ports were 8 feet 9 inches above the water-line, or 2 feet 6 inches higher than those of *La Gloire*. She was the first vessel in the British Navy to carry an armour-plated bow battery on the main deck. This armour plating also was carried upwards to protect an upper-deck bow battery mounted under the ship's forecastle. This arrangement enabled her to fire four guns ahead, while exposing to the enemy's fire only the curved surface of her bow armour. She also had a distance of 15 feet between each gun port on her main deck. Her engines of 1,000 h.p. nominal, and 6,000 indicated, drove a two-bladed Griffith's adjustable propeller 23 feet in diameter.

From 1860 to 1866 ten broadside ironclads were added to the navy, the last and the largest being the *Northumberland* of 10,780 tons. All these vessels, except the *Hector* and *Minotaur*,

carried muzzle-loaders, but these two had breechloaders of the early Armstrong screw type, which were soon superseded by more powerful weapons. The *Minotaur* carried fifty guns, the *Northumberland* twenty-six.

Then followed the abandonment of the broadside and the confinement of the heavy armament of an ironclad to a central battery protected by thick iron side armour and armoured bulkheads, the only other portion of the ship to be thus protected being that near the water-line. The first of these in the British Navy was the *Bellerophon*, launched in 1865 ; she was of 7,550 tons displacement, and her engines, of 6,520 h.p. indicated, drove one screw and gave her a speed of fourteen knots. Her thickest armour was 6 inches, and her heaviest gun a 12-ton muzzle-loader. Altogether she carried fourteen guns, including one in a small armoured citadel in the bows.

Great though the advantages were of the screw propeller, it was admitted that it was not without many drawbacks. The single screw took up a lot of room, weakened to some extent the structure of the stern, and if anything happened to the engines or propeller the ship was helpless and had to depend entirely upon whatever sail power she might possess. To overcome this difficulty Messrs. J. and W. Dudgeon were the first to build, from the designs of Mr. John Dudgeon, a twin-screw ocean-going steamship. Twin and triple screws had been used before, but were driven by the one engine.

Before this, however, Messrs. Dudgeon experimented with a small iron vessel, of 400 tons, called the *Flora*, which was given two independent engines and screws. The propellers were placed under the counter, and proved the advantage of this position over that of the practice, where two screws were used, of placing one before, and the other behind the rudder. The advantage of placing the screw either in a space cut in

the deadwood, or, in the case of twin propellers, under the counter, was much greater than the method at one time adopted of placing the screw behind the rudder. Under the newer method the steering power of the rudder was not impaired; but under the older method, when the screw shaft was carried beyond the rudder, a slit known as a "shark's mouth" had to be made in the rudder so that the upper and lower portions would be able to pass the screw shaft. The practice of equipping the vessels with wells or recesses into which the screw could be lifted was found to possess but slight advantages for warships, and was ere long abandoned. The best that could be said for it was that when a ship was travelling under sail only, the screw could be lifted from the water and the strain upon the wooden stern caused by dragging the screw, whether of the fixed or folded patterns, through the water, or running loose, was avoided altogether.

The *Hebe* was the third vessel on this principle built and engined by Messrs. Dudgeon, and the advantages of the twin-screw system over the single screw were again strikingly manifested during a series of manœuvres. The *Hebe* was an iron vessel of 470 tons, and 165 feet long. The screws were three-bladed, 7 feet 6 inches in diameter, and had a pitch of 15 feet, and were worked by two separate and independent engines each having two cylinders 26 inches in diameter, with a 21-inch stroke of piston, and being collectively of 120 nominal h.p. The tests showed that the vessel with both screws working ahead could made a complete circle in four minutes or less, and in still shorter time with only one screw working and the helm thrown over, or with the two screws working in opposite directions.

The tests were severe, but they proved more effectively than any tests before had done the great superiority of the

independent acting twin screw over the single screw; and the results in far greater manœuvring power, speed, and reliability were so satisfactory that the Admiralty was most favourably impressed. The Messrs. Dudgeon, in 1863, built the steamship *Far East,* and her launch and trial trip took place in the presence of the representatives of the Admiralty. She was fitted with twin screws which had a diameter of 8 feet 2 inches, and a pitch of 16 feet. The shafts of the screws were carried through a wrought-iron tube bolted to a false iron bulkhead clear of the ship's frame. The Admiralty not long afterwards adopted twin-screw propellers. The advantages of the twin screw were that were one to be disabled, the other could propel the ship without trouble, and that as an aid to steering, one screw could be sent astern and the other worked ahead, so as to turn the vessel in little more than her own length.

The *Penelope,* launched in 1867, was the first twin-screw ocean-going ironclad belonging to the Navy, and she was, moreover, the first government owned warship in which each screw had its own engine, as compared to the two screws geared to one engine in the floating batteries of the Crimean days. She was of 4,470 tons displacement, and her engines of 4,700 indicated h.p. gave her a speed of between twelve and thirteen knots. Each of her twin screws was fitted to a distinct stern with separate deadwood and rudder, an arrangement which neither added to the steering capabilities of the ship nor increased its structural strength at the stern. The *Penelope* had recessed ports to allow of increased training of the guns.

Captain Coles, to whom, notwithstanding the sad fate which overtook the *Captain,* this country is somewhat indebted for his consistent advocacy of the adoption of the turret on sea-going ships, urged upon the Admiralty the superiority of the turret over the broadside system. His contrivance differed

from that of Ericsson in the important particular that Ericsson's turret was supported on a pivot which rested upon bearings at the bottom of the ship, whereas Captain Coles's turret rested upon bearings supported in a specially constructed room resting upon the beams of the deck, which, in turn, were strongly supported from below. In regard to the thickness of armour there was little to choose between the two. Captain Coles brought his design before the notice of the United Service Institution in 1860, and although it attracted a great deal of attention among naval constructors and manufacturers of naval artillery, only one nation was then of sufficient courage to order an experimental ship. That nation was Denmark, and it is to that country that the honour must be given of having the first ship in which the broadside system of gun-fire was entirely abandoned and the turret system installed instead. This vessel was the *Rolf Krake*, an iron double-turreted monitor with lowering bulwarks. She was engaged in the war against Prussia, in 1864, when she took part in a fierce duel with the Prussian batteries at Eckernsünde. The batteries fired 24-pounder rifled Krupp guns, and though the ironclad was struck about one hundred and fifty times, her armour was sufficient to withstand the shot, and she certainly inflicted a great deal more damage than she received.

Numerous experiments were made in France and in this country with the object of determining the special characteristics of a vessel which should meet the rapidly altering condition of affairs caused by the increase of the power of the guns and the development of the torpedo from the stationary mine, which was so terrifying in the American War, to the torpedo which could attack a vessel at anchor, or even be directed at one moving slowly. The requirements were a moderate displacement, increased protection, and ability to carry heavier

guns capable of fore and aft fire as well as over the broadside. The problem was not an easy one by any means. The cellular double bottom system was extended as a precaution against torpedoes; the number of guns and the extent of the armour were lessened, but the thickness of the armour was increased in order to protect the vital parts and the guns from the fire of the newer and more powerful ordnance, while to compensate for the increased weight in the middle third of the ship, the beam was made greater in proportion to the length.

Matters were in this experimental stage when the first engagement was fought between European fleets, each of which included sea-going ironclads. The battle of Lissa, in 1866, was no less remarkable for the crushing defeat which the Austrians inflicted on the Italians than for the fact that that defeat was against all that the naval experts had considered to be the natural order of things. The Italian fleet was more numerous than the Austrian; it had more ironclads, its armament was greater, it had a greater number of wooden warships of various sorts and sizes; but as a powerful offset to all these advantages it had an amount of muddle and disorganisation truly appalling. The Italian fondness for big ships and big guns was as much in evidence in the fleet of 1866 as in the immense armoured ships *Duilio* and *Dandolo*, which that country built a few years later, and to which a more extended reference is made on another page. Its principal ships in the attack on Lissa and the subsequent engagement with the Austrian fleet were the *Re d'Italia* and the *Re di Portogallo*—two American-built vessels of 5,700 tons, old measurement. They were plated with armour 7 inches thick. They were designed to carry, the former two 150-pounders, and thirty 6-inch guns and four smooth-bore guns; and the latter two 300-pounders, and twenty-six 6-inch guns. These ships were poorly con-

FOUNDERING OF THE "AFFONDATORE" IN THE HARBOUR OF ANCONA.

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WRECK OF THE "CAPTAIN"

From a Contemporary Wood Engraving.

structed, and the design was so faulty that the rudders were left without protection and open to destruction by ramming or gun-fire—a weakness of which the Austrians took full advantage. There was also a turret ram called the *Affondatore*, 4,070 tons, built at Millwall, and armed with two 300-pounder Armstrong guns in two turrets, which was supposed to epitomise all the lessons of the American War. Her ram projected 26 feet, and what with this and her big guns and her thick armour, the Italians expected her to do wonders. As sea-boats the three were about equally bad. There were also two French-built small rams, *Terribile* and *Formidabile*, of 2,700 tons. The French at that time favoured comparatively small ships with large rams for coast and harbour defence, giving them iron plating 4½ inches thick, and 6-inch rifled guns as their principal weapons. Of the broadside ironclads there were four, of about 4,700 tons each, and belted from stem to stern at the water-line. There were, besides, two armoured gunboats which carried two 150-pounder Armstrongs and some smaller guns. The Italian fleet also had a number of steam-engined wooden vessels. The Austrian fleet had six very indifferent ironclads, slow, none too well armed, smooth-bores of no great size predominating, and a few other vessels, mostly of wood, of little fighting value, but capable of holding in check the Italian wooden ships for a time at all events. The Austrian ships were the *Drache, Kaiser Maximilian, Prinz Eugen*, and *Salamander*, whose tonnage ranged from 3,400 to 3,800, each carrying 4½-inch armour of home manufacture; the steam line-of-battle ship *Kaiser*, four steam frigates, and some smaller boats. These were practically ready for sea when hostilities were commenced. The two unfinished ironclads *Habsburg* and *Ferdinand Maximilian* were got ready in an improvised fashion and given smooth-bore guns; and the *Don Juan*, another

vessel in a state of even greater unpreparedness, had the deficiencies in her armour made good with heavy wooden beams. The Italians had two hundred and seventy-six rifled cannon to one hundred and twenty-one on the Austrian ships.

The Austrian Admiral, Tegethoff, was a man who left nothing to chance. He knew what he had to do, and he had that genius for command which enables a man to do his best with the materials at his disposal. Great though he knew the discrepancy to be between his own fleet and that of the Italians, it is a remarkable testimony to his organising power that he was able at the first glimpse he had of the Italian fleet to understand the extraordinary lack of cohesion that characterised it from first to last, and to prepare to meet it with every expectation of victory. He placed his fleet in wedge formation with the intention of breaking the enemy's line of ironclads with his own ironclads, so as to avoid subjecting his weaker vessels to the fire of the heavier Italian vessels, as might have been done had he attacked the Italian line near or beyond its centre. He also intended to ram the Italian ships whenever he had a chance, but though the chances later were numerous, the ram proved a less effective weapon than had been expected. The duty of the Austrian smaller vessels was to rake with their guns the Italian ships after the heavier Austrian ships should have thrown them into confusion, for owing to the longer range of the Italian guns and the heavier weight of their projectiles, the Italians had a superiority at long-range fighting which the Austrian commander was by no means disposed to allow them to turn to their advantage.

The ships on both sides were slow, those of the Austrians being worse even than those of the Italians. This may to some extent explain the comparative ineffectiveness of the ram, the blow being of not sufficient force to inflict much harm.

The Austrian ships were to "ram everything grey," the Italian fleet having been painted a conspicuous light grey which made them easily distinguishable; whereas the Austrian ships were black, but their funnels were differently painted, so that any one of them could be identified in a moment. The shock when the *Ferdinand Maximilian* rammed the *Re d'Italia* was not very violent, but, possibly on account of the weakness of construction of the hull, the ram did its work. A gaping wound was formed in its side through which the water rushed, and the great ship, after giving a couple of rolls, like some ocean leviathan in agony, heeled heavily over and went down, the first sea-going ironclad to be lost in this manner. The Austrians were appalled for the moment at the result of the experiment, for such, indeed, it was. Disablement had been expected, but that such a powerful ship should be sent under the waves in a few moments by a single blow was a result that had not been anticipated. The Austrian ship rammed three Italian vessels, but this was the only one of her victims to succumb. The *Re di Portogallo* received a similar attention from the *Kaiser*, but the blow, though delivered with all the force of which the ship was capable, did herself as much harm as the other, for she lost her bowsprit and foremast, and left her figure-head in the gap formed in the side where it was wrenched off by the blow. The *Kaiser* had previously passed three of the Italian ships, but thanks to her armour the few shots which struck her caused no damage. The *Re di Portogallo* was little the worse for the ramming, and when it had the Austrian ship at its mercy a moment later, lost, by delay and incompetence, the opportunity to pour in a broadside.

The *Kaiser* was not built to be used to ram heavy vessels, or else her designers had underestimated the resistance she would have to encounter in striking another ship, the iron

plates forming her bows being carried rather forward so that she had really a blunt projecting nose under water. Curiously enough, the only damage she sustained was a few plates started from the bows under the water-line.

As to the results of the fighting, the armour fully justified its use. The Austrian ships were struck several times by the heavy Italian shot and shells, but not once did the Italian projectiles penetrate both the armour and the backing, while for the most part the injuries caused by them were insignificant. The Italians lost two ironclads, and a third, the *Affondatore*, went down a few days afterwards as the result of the knocking about the Austrians gave her. But the injuries which caused the loss of these three Italian vessels were received below the water-line. Their armour was badly battered, but the ships themselves were little the worse. The 4-inch armour of one of the Italian ships was penetrated, but the backing prevented the shot going farther. The Austrians did not lose one ship, and on their armoured ships they had only three men killed, while on the wooden ships they lost thirty-eight killed and one hundred and thirty-eight wounded. The Italian losses are unknown, as a number of men were drowned when the two ironclads went under.

Even after the Italians were defeated they were still as strong as their opponents, but dared not attack them; while the Austrian commander deemed discretion the better part of rashness, and, contenting himself with having compelled the Italians to retire from Lissa, was confident that they would not attempt to attack him after the losses they had sustained, which had rendered them even more hopelessly disorganised than before the battle, if that were possible. The Italians, in spite of the vainglorious boasting in which they were pleased to indulge, were in no mood for another sea-fight. They were

short now of ammunition, and their sailors were completely disheartened. Some of the commanders and all the crews showed extraordinary bravery in maintaining the fight when the circumstances, though not the odds, were against them, but the other commanders were remarkable for incompetence and some of them for cowardice, for they had no plan of action, one at least fled as soon as the shooting began, and one or two others were careful to keep out of harm's way. The main lessons drawn from this engagement were that armour was indispensable in protecting a ship from the effects of hostile shot, and that the gun must remain the chief weapon of naval warfare. The advantage given to a numerically weaker side by superiority in organisation and efficiency had been too often demonstrated in previous engagements in the world's history to render attractive a repetition of the lesson, but it is to be feared that the need of such lessons at frequent intervals has not yet passed. It also showed that big ships and gigantic guns are not of much account if the men who are to use them are untrained, and that no matter how heavy the guns and far-reaching their range they are of little use if the gunners miss nearly every time. The Austrian concentration of fire upon a given spot, even though the firing were only maintained by comparatively small guns, told its own tale. Ramming only sent one ship down as the immediate result of the blow, but the moral effect of the fear of being rammed was very great, as no crew, seeing an enemy making straight for their ship, could foresee the result. In any case, the damage was sure to be considerable. Yet the Italian Admiral, when he had two splendid opportunities of ramming his opponents with his most powerful vessel, the *Affondatore*, deliberately turned his ship aside and shrank from delivering the blows. The battle was noteworthy for its demonstration of the importance

of accurate gunnery; nearly all the Italian projectiles passed over the Austrian ships, and the Italian gunners were heedless whether they fired when their vessels were on the upward or the downward roll. The trained Austrian gunners fired to hit.

Such lessons as the battle of Lissa was regarded as having presented were accepted, more or less, in the ironclads constructed in the five years immediately subsequent to that engagement.

The *Hercules*, begun in 1866, launched in 1868, and completed in 1869, was intended to combine the best features of the *Black Prince* and *Minotaur*. She was built entirely of iron, was 325 feet long between perpendiculars, 55 feet beam, and drew 34 feet 6 inches. The ram, a solid forging, weighed 5 tons, the armour plate was 8 to 9 inches thick, and weighed 1,145 tons; the weight of the bolts, nuts, and washers used in securing the armour plates was 73 tons, and there were also 91 tons of armour plates for the bulkheads, and 4 tons of bolts to secure them. The bulwarks were of wood, but below them were two iron strakes 6 inches thick, next a strake of 8-inch armour covering the lower portion of the main deck or central box battery, then two strakes of 6-inch plates, and then a belt of armour with a maximum thickness of 9 inches extending the length of the ship and amply protecting her some distance above and below the water-line; under this was another strake of 6-inch plates resting on the double skin of the hull itself. The 9-inch plates were backed by 10 inches of teak, inside which was an iron skin $1\frac{1}{2}$ inches thick supported by vertical frames 10 inches deep and 2 feet apart, further stiffened by other beams. From the lower deck downwards the wing passages were strengthened with 18 to 20 inches of teak, and backed by a $\frac{3}{4}$-inch iron skin, which was also most substantially

supported. The rest of the armour was backed by 10 or 12 inches of teak fastened to an iron skin 1½ inches thick, with a similar strengthening of vertical and longitudinal frames. She carried eight 10-inch 18-ton guns, four on either broadside, the two foremost and the two hindmost training through embrasures at the ends of the thwartship bulkheads and through recesses in the iron-clad sides. These four guns were established on what was known as Captain Scott's turn-table and racers. Two 12½-ton guns were in protected batteries on the same deck, one at the bow and the other at the stern ; three port-holes were provided for each of these guns, so that it could be fired either in line of keel or on either side as necessary. Their weight made her pitch deeply and recover slowly, thereby impeding her speed and lessening the value of her gun-fire. She also carried some 6½-ton guns on her upper deck. Special attention was paid to the protection of the rudder head and steering apparatus, events at the battle of Lissa having showed the imperative necessity of doing so. It was contended on behalf of the *Hercules* that her armour could not be penetrated by the guns of any ship afloat. The 18-ton guns were the heaviest ever worked in an ocean-going vessel up to that time, and were only 1½ tons lighter than the famous 15-inch Rodman guns, which were the heaviest that the American monitors had managed to work with success. Although the immense guns of the *Hercules* were muzzle-loaders, and discharged 400 lb. shots, it was found possible to fire the gun a second time in 1 minute 15 seconds after it had been fired once, but naturally this rate of firing could not be kept up for long owing to the overheating of the gun.

In the same year the *Monarch*, a full-rigged, double-turreted, ocean-going ship, was launched, with a displacement of 8,320 tons. Her turrets had 10-inch armour, while that of her belt and

bulkheads was 7 inches. Her engines were of 7,840 indicated h.p., and she had a speed of about fourteen knots. The *Monarch* was intended to have all the advantages of a turreted vessel combined with the freeboard of a sea-going ship. Her armament included four 25-ton 10-inch muzzle-loading guns, and some lighter weapons under her raised poop and forecastle, she being the first of the turreted vessels to have a secondary armament. The raised poop and forecastle were added to increase her seaworthiness, but though they accomplished this they only did so at the expense of her direct fire ahead and astern from her turret guns.

The adherents of the low freeboard sea-going turreted ship, as advocated by Captain Coles, pinned their faith to the *Captain,* which was launched at Birkenhead in 1869, and was of 6,950 tons register. Probably no warship's designs were ever more bitterly criticised and condemned by one party and upheld by another than those of the *Captain.* This ship had several features to recommend her, and several others which more than counterbalanced the conditions she was supposed to embody. The believers in the *Captain* argued that she represented what a sea-going turret ship should be, being powerfully armed, of good speed, well armoured, powerfully engined, and able to use extensive sail power if necessary. That she possessed all these qualities is unquestionable. Her engines of 900 h.p. nominal gave her a speed of thirteen knots. Her heaviest gun was the 25-ton 12-inch muzzle-loader. Her freeboard as designed was 8 feet 6 inches, but when she was in sea-going trim it was found that her actual freeboard was 6 feet 8 inches, through some error in the calculations, and this, added to the fact that she carried a large spread of canvas, caused many misgivings as to her stability. In two cruises in the Channel she gave every satisfaction, and it was contended

that she really had solved the problem of a low freeboard ship carrying canvas and turrets, and able to go to sea. Her third cruise, in company with the Channel fleet, marked the end of her career and of all the theories she was supposed to represent with such conspicuous success, for during a squall at night she rolled over and went to the bottom, taking nearly all on board with her, among the lost being Captain Coles. The exact circumstances of the disaster were never established; all that is known is that with her low freeboard and small margin of stability she rolled beyond the point at which recovery was possible.

As a reply to the *Monarch* the *Captain* was a failure, and the high freeboard turret ship was a success. Whether the *Captain* would have done better under steam alone it is impossible to say; perhaps she would, though she was under shortened sail at the time of the disaster. Some professed to believe that the hull would have been stable had it carried only one mast for signalling purposes, and suggested that another vessel should be constructed to take her place, but the experiment was never made. The *Captain* was too heavy for her size, and therefore lacked buoyancy; her weight was too much distributed, and she had not the power to throw off quickly the water she took on board, but "lay down under it," to use a seaman's expression.

Some six months before the *Captain* was lost a ship was launched which introduced another and most successful type, yet she was rather an improvement on certain earlier vessels than an entirely modern conception. This was the *Devastation*, and she was at once recognised as the most powerful ship of war in the world. The *Glatton*, a single turret ship, launched in 1869, may in some respects be regarded as the forerunner of the *Devastation*. The *Glatton* was a low freeboard coast-

defence monitor, modified to suit the conditions prevailing on the English side of the Channel; but the *Devastation*, while still being of comparatively low freeboard, was a sea-going ship, mastless, so far as sails were concerned, and double turreted.

The *Devastation* was the historical reply of the British naval constructors to the much-vaunted American monitors, and also the Admiralty's reply to the *Captain*. She was so unlike anything else afloat, that the writers of those days had difficulty in finding anything to which they could compare her. One describes her as like an "impregnable piece of Vauban fortification with bastions mounted upon a fighting coal mine." As a mastless turret ship or fighting machine, she possessed powers of offence, defence, and manœuvring greater than those of any other ship in the world. This ship, which was built at Portsmouth, and the *Thunderer*, built at Pembroke, were the pioneers of this class of vessel, and were the first to embody in their construction the most perfect examples of the turret principle as at that time understood, applied to a sea-going ship.* They were superior to any others built or building as fighting machines, and in their coal-carrying capacity. They were of 4,406 tons burden under the old system of measurement. They were given 12 inches of rolled armour plating on a teak backing built into an immensely strong framing, 18 inches in thickness, which was further backed with an iron skin $1\frac{1}{2}$ inches thick. There was not only the increased thickness of the armour, but also its quality to be taken into consideration in comparing these vessels with the *Warrior* and *Minotaur*, for the resistance offered by the rolled armour of the new ships increased very nearly as the square of the thickness, so that the sides of the *Devastation* and the *Thunderer* were, all things considered, about seven times as strong as those of the *Warrior*.

* *The Times*, 1869.

H.M.S. "DEVASTATION."

Photograph by Symonds & Co. Portsmouth.

The thickest armour carried in the French navy was that of the peculiar rams of the "*Taureau*" or "*Bélier*" type, mentioned on another page, viz. 8¼ inches, while that of the American monitors was 6 inches of plating on a system of armour stringers. The two English ships by reason of their higher freeboard were better sea-boats than any monitors built on the American principle could ever hope to be. The American turrets leaked badly whenever it was necessary to place their weight on the spindles to enable them to revolve, and their low sides allowed almost every other wave to wash over their decks. The turrets of the *Devastation* and *Thunderer* were worked on Captain Coles's system of rollers fixed at the circumference of the base of the turret and centring at the central cylindrical spindle, but their base rested upon the upper deck within the breastwork.

In measurements these vessels were considerably smaller than the *Warrior* or *Minotaur* classes. The *Warrior's* 4½-inch hammered plates would have offered little more resistance than so much glass to the heavy blows which the *Devastation's* guns could inflict, nor would the *Minotaur's* rolled plates have had much more defensive effect. Even when the *Devastation* was built, it was contended that the *Hercules* armour was practically impenetrable to the heaviest of British guns afloat yet, and that of the *Devastation* was three inches thicker still. One reason why this vessel was so strongly constructed was that she was built on an improvement of the bracketed frame system first introduced by the Admiralty in the *Bellerophon*. These improvements enabled a lighter framework to be constructed without reducing the strength, and the weight thus saved was put into the defensive armour. The *Devastation's* upper deck when the ship was in sea-going order was about 4½ feet above water, except at the bows, where a sunk forecastle raised

the height to 9 feet, and increased her capacities for going head to sea. The turret ports were 13 feet above the water, so that the guns were carried higher than those of any broadside-armed ironclad afloat. Those of the *Hercules,* for instance, were 11 feet above the water.

As at first designed, the *Devastation* would have had a less freeboard than the *Captain,* but after that disaster the plans of the *Devastation* were altered considerably, and the Admiralty committee decided that it would be safer and wiser to increase the freeboard amidships. This was done with iron plates raised to a level with the walls of the armoured breastwork, the freeboard for about half the ship's length being as much as 12 feet.

The turrets were placed one at each end of this breastwork, with the funnels, ventilators, and so on, between them. The breastwork deck, as it was called, was strongly plated as compared with the main-deck plating of all existing ironclads, and the protective plating of the upper deck was from two to three inches thick. Above the turrets was the usual hurricane deck. She carried two 30-ton guns in each turret, the guns being of an Armstrong type improved upon at Woolwich, and throwing projectiles weighing 600 lb., and of the Palliser pointed type. Her two turrets gave her an absolutely all-round fire, a consummation which was impossible with any vessel depending at all upon sails. Her engines, which constituted her sole motive power, were the largest which had yet been applied to working twin screws and were each of 800 h.p. nominal, and gave her a speed of twelve and a half knots.

She was 285 feet in length between perpendiculars, with an inside beam amidships of 58 feet, and an extreme beam of 62 feet 3 inches, with an average draught of 26 feet. The

depth from the midship portion of the covering-in deck to the top of the keel was 18 feet. The double bottom contained the water-tanks, and above these were a series of watertight compartments containing the engines and so on, and above these again were another series of watertight compartments used as coal bunkers and lockers, and another series, formed of watertight bulkheads, enclosed the officers' accommodation. They were said to be as strongly constructed as the strong room of a bank.

The *Devastation* was probably the first ship in which a built-up keel of steel was introduced. The plates of steel were §-inch in thickness, and the depth of the keel was 4 feet 6 inches, and it was strengthened by an angle-iron 1 inch thick. The stem was a solid forging, the upper deck part being 9 inches thick, and the lower part which formed the ram was 36 inches thick. This immense prow was strengthened by longitudinal iron frames. The stern-post was also forged solid, and was 26 feet in length and weighed 15 tons, and measured 12 inches deep by 8 inches thick. Steel plates riveted vertically over the transverse frames and running longitudinally and crossed by vertical fixed iron plating formed the double bottom. The interior of the hull was divided both longitudinally and transversely into a great number of watertight compartments. The two magazines, one near each end of the ship, were protected from a dropping fire by a bulkhead covered with 5-inch armour plating, and above the magazines again was a strongly constructed deck 4 feet 6 inches below the load water-line. The armoured belt was 9 feet 6 inches broad amidships, but tapered off gradually towards the ends. The armour-plating was 18 inches thick amidships, and gradually reduced to 9 inches towards the extremities. The breastworks or armoured walls built up from the upper deck near the forecastle, and extending

to a wall behind the after turret, were 7 feet high, 74 feet long, and had an interior breadth of 50 feet. Their armour-plating varied from 10 to 12 inches, with the usual backing of wood and iron frames, and an inner iron skin. The deck was 2 inches of iron covered with 4 inches of oak. The turrets, which stood at either end of the breastwork, were 31 feet 3 inches in exterior diameter, and 24 feet 1 inch interior diameter; they were built up as follows: Outside, 9 inches of iron plating, then 9 inches of Italian oak set in iron frames, then 6 inches of iron plating, then 6 inches of Italian oak set in iron frames, then two thicknesses of iron plating each $\frac{3}{4}$-inch thick, to form the inner skin, then iron frames 10 inches in depth, and finally a series of rope mantlets, or nets, to protect the men working the guns from injury through fragments of rivets or bolts being driven in by a shot striking the outside of the turret in battle.

The military mast was introduced in the sea-going turret ships like the *Devastation*, and a few years later all such masts were given fighting-tops or platforms upon which machine guns or small quick-firing guns were mounted, or were equipped with search-lights. These masts were of steel and hollow, and in some ships the tops could be reached by ratlines and shrouds in the old-fashioned way, and in others by means of internal or external ladders affixed to the masts themselves. Conning-towers were introduced later, but to meet the wishes of naval officers alternative places of control are also provided in all large ships, for use in case the conning-tower should be made the target for the concentration of the fire of a hostile ship.

The experiments with the *Glatton's* turret proved the unsuitability of turret armour being made with horizontal joints, as there is always the chance that a projectile may strike the actual line of joining, where the resistance would be less than

at any other part. The plates for the *Devastation* turrets were, therefore, rolled sufficiently broad to cover the faces of the turrets from the breastwork deck to the upper edge, and only vertical joints were exposed to fire. The forward end of the ship was raised to form what was called a sunk forecastle. This considerably added to the freeboard forward and to the buoyancy at that end of the ship, and this was further augmented by the armour belt being reduced as much as possible so as to avoid unnecessary weight. Some critics of this design maintained that the end was too weak, and that the advantage it was sought to gain in sea-going qualities would not materialise; but when the vessel afterwards went to sea and was tested in all sorts of weather, and against heavy seas, in broadside seas, and in following seas, and in seas running a few points off the bow, or on the quarter, she proved herself an admirable sea-boat. An account of the sea trials in which she was accompanied by the *Agincourt* and *Sultan* includes a description written by a "scientific observer," who was on board the *Devastation*. Her sea trials took place during the summer of 1873. The *Sultan* was one of the more modern ironclads carrying a two-deck battery on a protected water-line, and the *Agincourt* was a five-masted ship reminiscent of the steam frigate days.

The scientific observer states:—

"For purposes of comparison in pitching and lifting, etc., the *Sultan* had the height of the *Devastation's* upper deck at side painted on her in a broad white stripe, so that the behaviour of the two ships might be quickly appreciated apart from the records of instruments. The lowness of the extremities of the *Devastation* gives a great deal of interest to the pitching and lifting (really the longitudinal rolling) of the vessel. Two trials were made, one on the 9th and the other on the 15th of September. On the first of these occasions, she was accompanied by the *Sultan* only, and on the second she was accom-

panied by the *Agincourt* only. The seas met with on the 9th of September were lumpy and irregular, the wind having shifted somewhat suddenly during the previous night. Having got well out to sea, about forty miles off land, the wind was found to be blowing rather north of west with a force of a moderate gale, its speed varying from forty to forty-five miles per hour; and the largest of the waves were found to vary from 300 to 350 feet in length from crest to crest, occasionally reaching 400 feet—the greatest heights from hollow to crest being 15 and 16 feet. Going head to sea, at from six to seven knots, both vessels pitched considerably; the *Devastation*, however, had the best of it, pitching through smaller angles than the *Sultan*. The latter vessel was remarkably lively; at one moment she was to be seen with her fore-foot completely out of water, and the next with her bow dipped down to so great an extent that it was difficult to see from the flying deck of the *Devastation*—although the ships were pretty close together—whether the sea did not really break inboard; and this notwithstanding that the bow of the *Sultan* rises forward some 30 feet above the surface of the water. On the other hand, the forecastle deck of the *Devastation* was repeatedly swept by the seas, to each of which she rose with surprising readiness; indeed, it invariably happened that the seas broke upon her during the upward journey of the bow, and there is no doubt it is to this fact that her moderate pitching was mainly due, as the weight of the water on the forecastle-deck during the short period it remained there acted as a retarding force, preventing the bow from lifting as high as it otherwise would, and this, of course, limited the succeeding pitch, and so on. The maximum angle pitched through on this occasion, i.e. the angle between the extreme elevation and depression of the bow, was $7\frac{1}{2}$ degrees. Each vessel behaved extremely well when placed broadside on to the sea, rolling very little. The trial of the ship on the 15th of September, in company with the *Agincourt*, was by far the most severe of any. Early in the morning the vessel got under weigh and steamed out to sea, accompanied by the *Agincourt*. The wind was blowing with considerable force from the north-west, while the sea was at times very regular, long, and undulating; just the sort to test the rolling propensities of a ship, but scarcely long enough to be most effective in doing so, either in the case of the

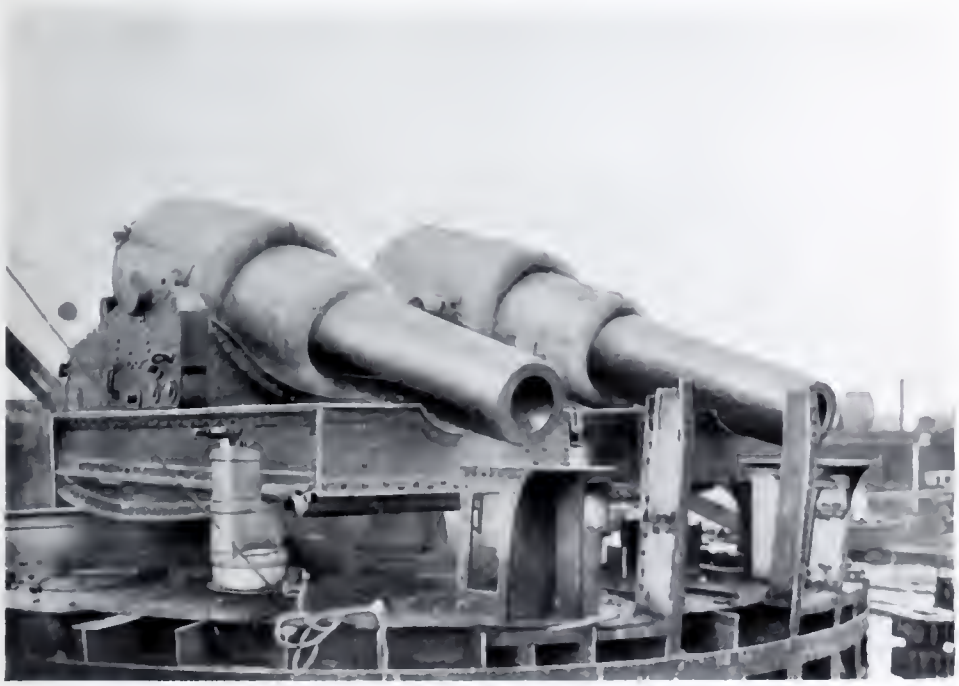
Devastation or *Agincourt*. The largest waves ranged from 400 to 650 feet long, and from 20 to 26 feet high. The ships were tried in almost every position with regard to the direction of the sea, and at various speeds, the result in point of comparison being extremely interesting, and, so far as the *Devastation* was concerned, very satisfactory. With the sea dead ahead, and proceeding at about seven knots, the *Devastation* pitched rather more than the *Agincourt*, although the great length of the latter compared with that of the former caused her bow to rise and fall through a much greater height, giving her the appearance of pitching through a greater angle. The usual angles pitched through by the *Devastation*, measuring the whole arc from out to out, were from 5 degrees to 8 degrees; the maximum angle pitched through was, however, 11¾ degrees. The scene from the fore end of the flying deck when the vessel was thus going head to sea was very imposing. There was repeatedly a rush of water over the forecastle, the various fittings, riding-bitts, capstan, anchors, etc., churning it up into a beautiful cataract of foam; while occasionally a wall of water would appear to rise up in front of the vessel and, dashing on board in the most threatening style, as though it would carry all before it, rushed aft against the fore turret with great violence, and, after throwing a cloud of heavy spray off the turret into the air, dividing into two, pass overboard on either side. All the hatchways leading below from the upper deck were closed; it was not, however, thought necessary to close the doors in the sides of the trunks leading from the main hatchways to the flying deck, most of the men on deck preferring to remain here under the overhang of the flying deck. It was quite the exception for the water coming over the bow to get much abaft the fore turret; but this, however, occurred occasionally. The foremost turret makes a most perfect breakwater; it receives with impunity the force of the water, which, after spending itself against it, glances off overboard, leaving two-thirds of the deck seldom wetted. There was one sea which came on board, while thus proceeding head to sea, which was much heavier than any other; it rose in front of the vessel some 10 or 12 feet above the forecastle, and broke on the deck with great force, for the moment completely swamping the fore end of the vessel. A mass of broken water swept up over the top of the fore turret,

and heavy volumes of spray extended the whole length of the flying deck, some small portion of it even finding its way down the funnel-hatchway—which had been left uncovered—into the fore stokehole. It should be borne in mind that the angles pitched through, given above, do not measure the inclination of the ship to the surface of the water, but only her inclination to the true vertical. Pitching and lifting are produced by the vessel endeavouring to follow the slope of the waves, or, roughly speaking, to keep her displacement the same as in still water, both as to volume and to longitudinal distribution.

"As to the depressing effect of the water on the bow, a layer of water one foot deep over the entire forecastle exerts a pressure of 65 tons; this will produce a change of trim of 11 inches, together with an increase in the mean draught of $1\frac{3}{4}$ inches; i.e. the draught of water forward will be increased by $7\frac{1}{4}$ inches, while that aft will be diminished by $3\frac{3}{4}$ inches. A layer 2 feet deep will have double this effect; one 3 feet thick will have treble this effect; and so on up to a considerable angle. This follows from the fact that the front slope of the longitudinal curve of stability, up to a considerable angle, is very nearly straight. Hence the effect, even of a large body of water passing over the forecastle, tending to make the vessel dive down head foremost, is small, and of no importance. It modifies, however, the transverse stability. When proceeding head to sea there was no appreciable rolling motion. With the wind and sea on the bow she pitched considerably less than when going head to sea, but rolled through 5 degrees or 6 degrees. With the wind and sea abeam, lying passively in the trough of the waves, the maximum angle rolled through was 14 degrees from port to starboard, $6\frac{1}{2}$ degrees to windward, and $7\frac{1}{2}$ degrees to leeward, and this without perceptible pitching. When, however, proceeding at about seven and a half knots, with the wind and sea on her quarter, she rolled through $27\frac{1}{2}$ degrees from port to starboard, 13 degrees off the perpendicular to windward, and $14\frac{1}{2}$ degrees off the perpendicular to leeward, besides also pitching through some 4 or 5 degrees. This is by far the greatest angle she has ever rolled through. It is the apparent period of the waves, i.e. their period relatively to the ship, which operates in making a vessel roll. The motions of the vessel, both as to pitching

THE OLD 'DREADNOUGHT."

Photograph by J. Sankey, Barrow.



THE BIG GUNS OF THE OLD "DREADNOUGHT."

Photograph by J. Sankey, Barrow.

and lifting and to rolling, were extremely easy. She, indeed, claims to have behaved better than her companion, the *Agincourt*. Certainly, her rolling motion was somewhat slower, and she rolled less deeply; when the *Agincourt* was rolling 17 degrees from port to starboard, the *Devastation* was only rolling 14 degrees. As to pitching, the *Devastation* may fairly claim to have had the advantage, for, as we have seen, although the *Agincourt* pitched rather less, her bow moved vertically through a greater distance, so much so that while going head to sea at seven knots she shipped a sea over her high forecastle, showing that she could not be driven under the circumstances at a much higher speed with at least anything like comfort."*

The *Thunderer*, a sister ship in some respects to the *Devastation*, and the *Fury*, afterwards called the *Dreadnought*, followed, but each one included improvements and modifications suggested by the experience gained with the *Devastation*. Hydraulic machinery was installed for working the 38-ton guns of the Woolwich rifle pattern, but in the *Thunderer* the two 35-tons were worked by hand. Their guns were by no means generally approved, many artillerists being of opinion that Whitworth hexagonal guns would have been better.

The important feature in the *Thunderer*, and one which contributed very materially to her safety, was the introduction of a longitudinal watertight bulkhead between the two sets of engines and boilers, so that if one set should be disabled from any cause, the vessel would still have the other set to depend upon. The *Dreadnought* was engined on the compound system, which gave her a better speed on a proportionately less coal consumption.

It is an old saying that the speed of a fleet is that of its slowest ship. When the situation was further complicated by the varying sailing powers of the ships the difficulty of the admiral in command to keep his fleet together must some-

* King's "The Warships of Europe."

times have been very great. Admiral Yelverton, for instance, when in command of a Channel squadron, in 1866, consisting of the *Caledonian, Lord Clyde, Bellerophon, Achilles, Hector, Pallas, Ocean, Wyvern, Research,* and *Helicon,* reported that he "took every opportunity of trying them to their utmost, always placing them in positions as to wind and sea most likely to test their capabilities as sea-boats, without much regard to the safety of their spars or the risk of shipping far more water than under ordinary circumstances ships of war would be exposed to. . . .

"The *Pallas* and *Research* were the only two ships that could not keep company with the squadron. The *Pallas* appeared to plunge heavily, and carried away her jib-boom, but took her place in the squadron on the following morning. The *Research,* from her very small steam power, was out of sight at sunset, and put into Plymouth to fill up with coal. On the 23rd we reached the prescribed rendezvous . . . when steaming ceased for a while, and the trials of sailing began." The ships varied as much under sail as they did under steam.

The *Wyvern,* which was not a good sea-boat, and her sister ship, the *Scorpion,* were built for the Confederate States, in 1864, at Birkenhead, and were bought by the British Admiralty. They were 220 feet by 42 feet, and of 1,827 tons, and had engines of 350 nominal h.p. Each had two turrets containing two 300-pounders. They had ram bows, and, except on the poop and forecastle, the bulwarks could be let down when the ships were cleared for action.

The *Pallas,* an armour-plated six-gun ship, and the *Research* were given recessed ports, in order to increase their firing range, but the ports were constructed angularly and did not allow the guns to be sufficiently depressed to hit a small boat close

at hand; thus the weapons would have been no defence against a torpedo-boat attack, if the latter got to close quarters. This fault was remedied in the Venezuelan transport and cruiser *Bolivar*, in which the recessed ports were fitted under the personal superintendence of their inventor, Captain Symonds, and were slanted outside the gun ports so that they would allow of a gun being depressed to strike a small boat lying nearly alongside, while their wall was curved instead of flat as in the British ships mentioned. Her sister ship, so far as dimensions were concerned, the *Mary*, was devoted to the more peaceful requirements of the cattle-trade between London and Gothenburg. The *Bolivar* was a twin-screw vessel, and it is curious to note that even then, when this method of propulsion had proved its superiority, it was gravely stated concerning her trials that "To keep time in all weathers and in all seasons nothing is superior to the paddle, but in long voyages, especially where sails are occasionally used, the screw may be employed with advantage."*

Several vessels followed in rapid succession after the turret ships, and an upper deck battery was added in the *Sultan*, a vessel which otherwise much resembled the *Hercules*, and then followed a class to which the *Iron Duke* and *Vanguard* belonged. The conditions imposed in the construction of this class were that they should draw 22 feet 6 inches of water, that they should carry armour not less than 8 inches thick at the water-line and 6 inches elsewhere except at the bow and stern, that they should have a speed of thirteen and a half knots, and that their guns should be capable of firing in any direction. This class was named after the *Audacious*, and proved fairly successful. The principal event which distinguished the class was the accidental ramming of the *Vanguard* by the *Iron Duke*, in

* *Daily Telegraph*, July 16, 1866.

September, 1875, off the coast of Ireland. They were all broadside ships, and the type was brought much nearer to perfection in the *Alexandra*, which was then the largest masted ironclad that had ever been designed; and though she was a central battery ship, four of her twelve guns could fire right ahead, and two right astern, and four to six guns could fire one either broadside. She carried two Woolwich rifled muzzle-loading guns of 25 tons each, and ten 18-ton guns. The two big guns were placed in the upper deck battery forward. As a further protection, besides her armour, the main deck battery between decks was divided in two by an armoured bulkhead. She was the first cruising armoured broadside ship in the British Navy to have engines on the compound system, and her twin screws were each driven by an independent set of engines with an aggregate indicated h.p. of 8,000. Her speed at her official trials was about fifteen knots.

Yet another type of turret ship was the *Temeraire*, launched in 1876, which marked a noteworthy combination of the central battery and barbettes or turrets. Her upper-deck armament was in two fixed turrets open at the top and pear-shaped instead of circular, and placed, one near the stern and the other near the bow. These stood about 6 feet above the deck, and measured about 33 feet by 21½ feet. They were placed with their length in the direction of the ship, and the rounded end of each pear, if it may so be called, was towards the nearer extremity of the vessel. Inside each of these batteries was a turn-table, hydraulically worked, on which was mounted a 25-ton gun borne on a carriage after the Moncrieff principle. This permitted of the gun being loaded in the turret and raised above it to be fired. The recoil caused it to sink into the turret to be reloaded. An armoured tube or hoist communicated with the ammunition chambers below, and the

gun always had to be brought back into the same position for reloading. It will thus be seen that the guns were fired as barbette guns and loaded as turret guns, and many were the discussions as to the category in which they ought to be placed. The armour of the fore turret was 10 inches thick, and that of the rear turret 8 inches. On the main deck was a divided battery. The front portion had two 25-ton guns firing through ports at the corners, which were provided with oblique armoured bulkheads, and the guns were pivoted at the muzzle to allow of a fire from right ahead to abeam. The other portion of the battery was given four 18-ton guns to be fired on the broadside. She was preferred as a fighting ship by many to the *Alexandra*, which preceded her, in which the main armament was carried in a central battery. The *Temeraire* was heavily armoured down to below the ram, to protect her from an attempt to rake her bows when pitching, for it will be evident to anyone that when the fore part of a vessel is on the crest of a wave the bows are greatly exposed, sometimes nearly to the foot of the stem, and would be peculiarly vulnerable to hostile shot. The last central battery ship for the British Navy was the *Superb*. She was built to the order of the Turkish Government, but was acquired by this country. She carried sixteen 10-inch muzzle-loading rifle guns and six 4-inch breechloaders. She was a sister ship to the Turkish armour-clad *Mesoudiye*.

Though not launched until 1876 and completed in 1881, the *Inflexible* was described by her designer, in 1874, at a meeting of the Institution of Naval Architects as follows :—

" Imagine a floating castle, 110 feet long and 75 feet wide, rising 10 feet out of water, and having above that again two round turrets, planted diagonally at its opposite corners. Imagine this castle and its turrets to be heavily plated with armour, and that each turret

has two guns of about 80 tons each. Conceive these guns to be capable of firing, all four together, at an enemy ahead, astern, or on either beam, and in pairs towards every point of the compass. Attached to this rectangular armoured castle, but completely submerged, every part being 6 to 7 feet under water, there is a hull of ordinary form with a powerful ram bow, with twin screws and a submerged rudder and helm. This compound structure is the fighting part of the ship. Seaworthiness, speed, and shapeliness would be wanting in such a structure if it had no addition to it; there is, therefore, an unarmoured structure lying above the submerged ship and connected with it both before and abaft the armoured castle, and as this structure rises 20 feet out of water from stem to stern without depriving the guns of that command of the horizon already described, and as it moreover renders a flying deck unnecessary, it gets over the objections which have been raised against the low freeboard and other features in the *Devastation*, *Thunderer*, and *Dreadnought*. These structures furnish also most luxurious accommodation for officers and seamen. The step in advance has, therefore, been from 14 inches of armour to 24 inches; from 35-ton guns to 80 tons; from two guns ahead to four guns ahead; and from a height of 10 feet for working the anchors to 20 feet. And this is done without an increase in cost, and with a reduction of nearly 3 feet in draught of water. My belief is that in the *Inflexible* we have reached the extreme limit in thickness of armour for sea-going vessels."

Seeing that the *Inflexible* had armour two feet thick, the belief of her designer that the limit had been reached was justifiable. She was the only one of her class built for this country, though Italy, as will be seen, tried to copy and even to improve upon her. Her displacement was 11,800 tons, and her engines of 6,500 indicated h.p. were designed to give her a speed of twelve and a half knots, though on occasion she attained nearly fifteen knots. Her length was 320 feet, beam 75 feet, and draught 26 feet 4 inches. Her armament consisted of four 16-inch muzzle-loading rifled guns in her turrets and eight 4-inch breechloaders, besides twenty-one anti-torpedo boat guns

H.M.S. "INFLEXIBLE," 1880.

Photograph by Symonds & Co., Portsmouth.

and four torpedo tubes. The weight of a single discharge was 6,800 lb., which was not exceeded until 1906, though the energy in foot tons in that interval was increased several times over. She was, moreover, the first vessel in which the turrets were placed *en echelon*, i.e. diagonally, instead of one behind the other on the centre line.

The affection of the Italians for immense ships and guns to match was demonstrated even more remarkably by those which were built after the battle of Lissa than by those which took part in that memorable and disastrous engagement. Probably the two finest specimens were of the mastless turret type, the sister ships *Duilio* and *Dandolo*, which were designed to surpass any other fighting ship in existence, no matter what her nationality, and especially to show that Italian naval architects and constructors could surpass the *Inflexible*, on which Britain so justly prided herself. The *Duilio* was built at Castellamare, and the *Dandolo* at Spezzia. Their turrets were on much the same plan as those of the *Inflexible*, and quite a dispute arose between Italian and British naval architects as to whom the credit should be given of having first designed this type of ship.

The *Duilio* was of 10,650 tons displacement; her length between perpendiculars was 339 feet 7 inches, her extreme breadth 64 feet 7 inches, and her mean draught was 25 feet 11 inches. The height of her main deck above water was 11 feet, and that of her battery 15 feet 9 inches. The hulls of both these ships were built of iron and steel. Each had a double bottom extending for 230 feet of her length, and the numerous watertight compartments into which the double bottoms were subdivided were so arranged that any one or more of them could be filled with water or emptied as might be found necessary.

The central armoured citadel protecting the machinery and boilers and the magazines, besides part of the machinery for working the turrets and the guns, was no less than 58 feet in breadth, and extended to within a fraction of 6 feet below the load water-line, and was 107 feet in length. Above the citadel was a second central armoured compartment protecting the turret bases and a part of the machinery for loading and working the guns; and above this compartment were the turrets themselves. The turrets of the *Duilio* were not placed amidships, but the experiment was tried for the first time on an Italian ship of setting them at opposite corners of the central citadel, so that one should command the stern and the other the bows, and that each should be able to fire ahead or astern, or on the broadside, without interfering in any way with the other. The decks before and abaft the citadel were 4 feet 9 inches below the water-level, and were protected by horizontal armour. Extensive experiments were conducted at Spezzia with a 100-ton gun, and guns of 10- and 11-inch calibre, on different types of targets. As first designed these ships were to carry two 60-ton guns in each turret, but when the British Admiralty announced that the *Inflexible* would have guns of 81 tons, the Italians equipped these two warships with 100-ton guns manufactured at the Elswick works. The armour at the water-line was 22 inches thick on the central portion, and that of the turrets was 18 inches, further strengthened by heavy teak backing. Each ship had a heavy projecting ram, and also had an apparatus for discharging Whitehead torpedoes. Although these ships were described as Italian-built and were certainly put together in Italy, it is interesting to note that the *Duilio* had trunk engines by Messrs. John Penn and Sons, that practically all the iron and steel put into the vessel's frames, etc., were made in France,

that the armour-plates came from Cammell's establishment at Sheffield, and that the guns were made at Elswick. Only the heavy forgings for the ship were made in Italy. The *Dandolo*, although described as a sister ship, differed in many particulars from the *Duilio*. The *Dandolo* had engines of Maudslay's inverted vertical compound type, a pair of which was given to each of her screw propellers, and she had eight boilers, heated with thirty-four furnaces, and working at a pressure of 60 lb. per square inch. These great ships were out of date soon after being completed, as the discovery of the means of making steel cheaply, and the much greater strength and lightness of the homogeneous metal, as it was called, rendered it possible for ships and guns to be built of much greater power than ever before. Indeed, so great was the progress in these two departments that in a very few years these vessels would no longer have been invulnerable, but would have been relegated, as being slow and unwieldy, to harbour or coast defence work, and thence to the scrap-heap.

One remarkable ship on the turret system was the *Peter the Great*, belonging to Russia, which was very like the British turret ship *Devastation*, and carried four 12-inch guns in her two turrets. She had no ram. Russia also possessed the *Minin*, which carried turrets on Captain Coles's system and had a very low freeboard, but after the loss of the *Captain*, the *Minin's* turrets were removed, and she was given a central battery, 98 feet in length and rising 10 feet above the water-line. The guns were mounted *en barbette* and were placed on turntables. Russia also had two three-turret ships carrying six 25-ton rifled guns, and two double-turret ships each carrying four 35-ton guns, besides a considerable number of single turret ships and some smaller two-turreted vessels. These were mostly monitors copied from Ericsson's plan, and were

similar to those which he designed for the war in America. Most of these turrets were on Captain Coles's system.

The turret system was developed to such an extent by Admiral Popoff that he gave his name to the type of ships he designed. They were immense circular floating fortresses intended only to operate in shallow and comparatively smooth water. Their sea-going qualities were conspicuous by their absence, which is not to be wondered at when their shape is taken into consideration. Although described as circular it would be more correct to say that they were circular only at the water-line, for on one side to form a stern a projection was constructed to facilitate steering, and at the opposite side a bow was built on. These ships carried on the central part of the upper deck a circular breastwork 7 feet high, in which were two 12-inch 40-ton guns, two quick-firers on each side of the superstructure, and six smaller guns, mounted *en barbette* 13 feet 3 inches above the water-line, on fixed slides. When it was necessary to train or change the direction of the guns, the whole ship had to be turned. In the citadel was the accommodation for the officers and crew. The extreme diameter of the vessel was 121 feet, the length over all, including the stern and bow, was about 150 feet, and her total displacement was 3,553 tons. She drew only 13 feet. The ship was built of iron, and had a double bottom sheathed with wood and copper. She was, of course, flat-bottomed. A peculiar feature of her construction was that she had a dozen external box girders or keels, each about 12 inches square, carried parallel to the intended axis of the vessel. There were eight radial frames and two rings of web frames, the vessel being divided into twenty-four compartments. These two vessels, the *Admiral Popoff* and *Novgorod*, were alike in most particulars, except that the latter was the smaller of the two. The height of

the armour on each vessel was 1 foot 6 inches above the water-line, while below the water-line it was 4 feet 6 inches; they each had six screw propellers driven by three sets of engines. Their average speed was about six and a half knots. Although Admiral Popoff is usually given the credit of the invention of this type of vessel, Mr. John Elder, the Glasgow shipbuilder, designed and patented a circular floating battery in 1867. He proposed that the circular ship should carry twenty-six guns in a lower battery and ten in a central one, and that the sharp edge of the circumference should be used as a ram. According to his design his vessel would have had a diameter of 144 feet, a freeboard of 6 feet, and a draught of 9 feet.

The great ironclads described and their armament represent what may be regarded as the apotheosis of the iron turret ship and the heavy iron gun. Before passing on to the great change introduced by the adoption of steel in shipbuilding and gun manufacture it may be as well to note something of what has been accomplished in the production of warships of other types and modifications of types, and how some of them acquitted themselves in actual conflict.

One drawback to all the heavy British ironclads of this period was that so much weight and space were taken up by the armour and its backing, that comparatively little space was left for bunker accommodation. Obviously the very heavily armoured ships could not travel for long at high speed under steam without exhausting their coal supply. In order to obtain speed and allow space for the engines of the necessary dimensions, together with adequate coal supplies, the amount of armour carried had to be reduced, and in July in the summer of 1869 the first of a new class of armoured frigates, the *Inconstant*, was launched for the Navy. She was constructed of iron sheathed with three thicknesses of wood and coppered.

She was the first vessel which had a stern post and rudder frame made of brass. She carried sixteen guns, viz. ten 9-inch muzzle-loading guns on the main deck, and six 7-inch muzzle-loading rifles on the upper deck; her engines, of 1,000 h.p. nominal, gave her a speed of about sixteen knots, at which she was faster than any other warship in the world. She was unusually narrow for her length, in order to add to her speed, her length being 337 feet 4 inches, and her beam 50 feet 3½ inches. At one time on her trials she made nearly eighteen and a half knots.

A series of coast-defence monitors was decided upon in deference to public clamour, and the first of these, the *Glatton*, was begun in 1868, and finished in the latter part of 1870. She was intended to be for coast-defence purposes only, and not an ocean-going ship in any sense of the term. Consequently her coal capacity was small, and she was very heavily armoured. She had but one turret, and this was so disposed that as the vessel had no masts the turret could be turned to give the guns a range of fire all round except for a small section astern, only about 20 degrees being thus uncovered. Although her design was admittedly founded upon the American monitor type, several important improvements were introduced. The American monitors had shown on several occasions that a heavy shot striking near the base of the turret was liable to cause the turret to jam or become unworkable. To render this impossible in the case of the *Glatton* she was equipped with a heavy breastwork built outside the base of the turret, in such a position that the lower part of the turret was absolutely protected and consequently could not be disabled, while if a shot were to strike the upper part of the turret it would do little damage. The *Glatton* had a freeboard of only 3 feet; the hull was plated with iron 12 inches thick above the water-

line, and 10 inches thick below it, and behind this was a teak backing 20 inches thick, and behind this again two thicknesses each of 1 inch of iron forming an inner skin, while the frames to which this was attached were no less than 10 inches deep, and were only 2 feet apart. Altogether the sides of this vessel were 3 feet 8 inches in thickness. The turret contained two 25-ton guns; its armour was 14 inches thick in the most exposed parts, and 12 inches thick elsewhere. And besides this it had a wood backing of 15 inches, and an iron inner skin $\frac{5}{8}$-inch thick. It was 30 feet in diameter, and similar to the turrets of the *Captain* and *Monarch*. The breastwork rose $6\frac{1}{2}$ feet on each side of the vessel from the upper deck, and was plated with 12 inches of iron, with a 15-inch backing of teak. The upper deck had a sheathing of 3 inches of iron. The total length of the vessel was 245 feet, its breadth 54 feet, and it drew 19 feet of water. It was of 2,700 tons burden, and the engines were of 500 h.p. nominal. Its bunkers were designed to carry 250 tons of coal, but its ballast tanks were so designed that if necessary they could take another 250 tons of coal. With such dimensions and such a weight of armour to carry, she was, of course, a slow vessel, but in regard to her fighting power it was estimated that she would give a good account of herself against even such a vessel as the *Monarch*.

Powerful though the *Glatton's* turret appeared, the experimental turret on the same pattern fired upon at Portland by the 21-ton gun of the *Hotspur* suffered somewhat badly. The shot struck the turret at the horizontal joint of the upper and lower plates, forcing the upper plate and the lower plate apart and damaging the turret generally.

A series of breastwork monitors was added to the Navy in the late 'sixties. Besides the *Magdala*, *Cerberus* and *Abyssinia* for colonial coast and harbour defence, the Admiralty ordered

four similar but larger vessels for home defence, much to the general surprise. For some unfathomable reason the *Cerberus* and *Magdala* were barque-rigged. False bows and sterns were added to them to enable them to make the voyages to their respective destinations. They carried two 18-ton guns in each of their turrets. On her outward voyage the *Cerberus* earned a reputation for rolling which she never lost. The first reports of her voyage as far as Gibraltar described it as being successful and prosperous, but when her commander's report was received it showed that the voyage was successful in the sense that the ship succeeded in getting that far, but prosperous it never was. She had dirty weather in crossing the Bay of Biscay, and for twelve hours rolled so heavily that it was thought she would not get through it. It is said she rolled 40 degrees each way, which is far more than the *Captain* rolled, and she pitched so heavily that sometimes the whole fore part of the ship as far as the foremast would be lost sight of, and the decks be quite under water. She was very slow under steam, the utmost speed that could be got out of her being six knots. The crew detested her so thoroughly that they deserted whenever they found the opportunity, three of them had to be punished and sent to prison by way of example by the time Malta was reached, and six volunteered to go to prison rather than continue the voyage. However, she arrived at Melbourne at last, and lay year in and year out at her moorings in Hobson's Bay except for such short intervals when she went down the bay for firing practice. One of the war scares which arise from time to time came near to conferring on the *Cerberus* a celebrity of a unique character. Irresponsible and irrepressible politicians of a sort find colonial life offers them more scope for the display of their exuberance, and as the scare revived the question whether the defences of Melbourne at

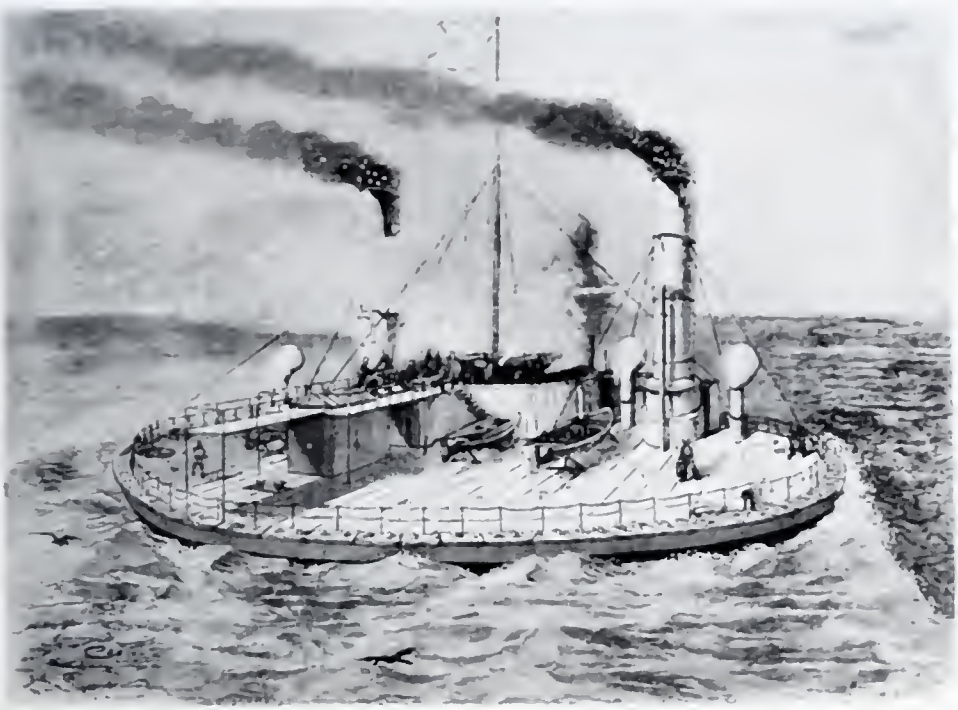
Queenscliffe were sufficiently strong, a politician of this variety proposed that the *Cerberus* should be sent out to sea and then endeavour to steam back past the batteries, which should fire upon her, in order to test both her armour and the strength of the defences. Strange to say, this suggestion actually met with some support, notwithstanding the chorus of ridicule and protests with which it was received, but the common-sense of the community vetoed the proposition. At the time of their construction these three vessels were the most powerful warships of their size to be found anywhere, and were among the ugliest.

In the early 'seventies there were added to the British Navy, and less numerously to other navies, several vessels of composite construction. That is to say, that all her framing was of iron and the outside and deck planking was of wood. Most of these vessels were sloops or light cruisers, and though they were useless for defensive purposes against armoured ships, their offensive powers were very great for vessels of their size, as they were generally given four of the heaviest guns it was possible for them to carry. Under steam they were fast, but as their bunker capacity was not large they had to depend on their sails when possible. One of these vessels, which may be regarded as a specimen of her class, the *Albatross*, was 160 feet in length between perpendiculars, of 894 tons displacement, and carried two 4½-ton 7-inch muzzle-loading rifled guns, two 64-pounder guns, and the usual number of smaller weapons for boat and land service.

One small corvette, the *Druid*, had an innovation which must have brought tears to the eyes of sailors of the old school who loved the ship's figure-head, and were never tired of keeping it clean and brightly painted. The necessity of end-on fire and bow chasers was admitted, and some unsentimental

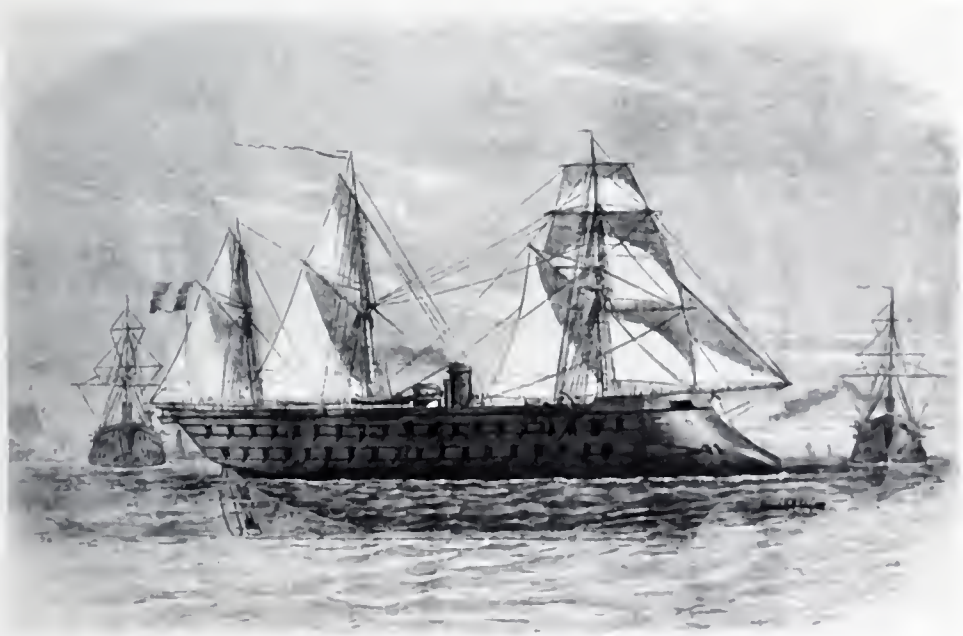
reformer actually had her figure-head constructed so as to open in two parts like a folding door to permit of the space being used as a porthole for a heavy bow gun.

The steam engine as a means of propulsion was not to be allowed to remain unchallenged, but the only attempt at rivalry to merit serious consideration was that associated with the *Waterwitch*, in 1866, and Mr. Ruthven's system of hydraulic propulsion. Although the first patent was taken out in 1839 and another followed in 1849, and a small boat fitted with the Ruthven machinery was placed on the Thames and a working model was shown at the Exhibition of 1851, engineers did not take kindly to it. The objections, apparently insuperable, were that the water had to overcome the resistance of a very large rubbing surface, and that the perforated bottom of the ship was liable to be choked in shallow water, and it was also contended that the cost of increasing the power beyond a certain rate was prohibitive. The advantages of the system, and they were undeniable, were that the ship could be propelled either end foremost, or turned, or brought to a stop and restarted without stopping or reversing the engines. A vessel was built, partly at the expense of the Prussian Government, and fitted with engines of this type, and was said some years afterwards to be still running on the Oder. In 1863, Mr. Murray, Chief Engineer of Portsmouth Dockyard, reported, on the application by Mr. Ruthven, of Greenock, for an extension of his father's patent, that he saw no reason why the speed attained with the Ruthven propeller should not equal that obtained with the paddle or screw, and that he had been on official duty for the Admiralty to Belgium to inspect and report upon a vessel built by the Cockerill firm and called the *Seraing*, which was equipped with the Ruthven propeller. He recommended the Admiralty to give the principle serious attention.



RUSSIAN CIRCULAR MONITOR "NOVGOROD."

From a Contemporary Wood Engraving.



THE FRENCH IRON-PLATED SHIP "MAGENTA."

From "The Illustrated Times."

In consequence of this report the Admiralty ordered the *Waterwitch* to be built for the trial of the Ruthven propeller. In order to check the vessel by a comparison with one fitted with the ordinary screw, the trials of the armour-plated twin-screw gun-vessel *Viper* were selected. The *Waterwitch* was of iron, 778 tons measurement, 162 feet in length by 32 feet beam, and 13 feet 9 inches depth; she was rather broad in proportion to her length, and had a rudder at both ends. Her armour plating was of the usual 4½ inches in thickness at the water-line and on her broadside, and she had athwartship armoured bulkheads across her upper deck with gunports in them, through which it was proposed to fight guns on the line of keel. The main interest of the vessel centred in her machinery. Her first trials on the Thames were so satisfactory that a more extended series at Stokes Bay was determined upon, the two sets of trials lasting about a year. A portion of her bottom was made flat and without external keel. From what may be regarded as a semi-official and certainly expert report of the ship and the Stokes Bay trials, the following description of the vessel may be quoted :—

"In the fore part of this flat surface, in a space about 12 feet square, are one hundred and forty-four perforations 12 inches each in length, and cut laterally through the bottom plates of the vessel, the plate being bent inwards on each side of the cuts to a central depth of about 3 inches. Through these perforations the water on which the vessel is floating finds admission to an oblong iron box, fixed longitudinally and parallel with the vessel's keelson, closed when the vessel is not under steam by four sluice valves, each having an opening of 2 feet 10½ inches by 1 foot 11½ inches. With the vessel under steam these valves are open, and give further admission to the water to the watertight cast-iron casing, in which is fixed, on a vertical axis, the turbine. This wheel is 14 feet 4 inches in diameter at the bottom plate, and 14 feet at the top. It has twelve blades, and

these, with the top and bottom plates, are made of boiler plate about ⅜-inch thick, vertical at the periphery and with the lower edge gradually twisted from near the circumference towards the centre in the direction of its motion. From the cast-iron casing which encloses the wheel, branch off laterally copper pipes, which convey the water from the wheel, or centrifugal pump as it might not inaptly be called, to the discharge pipes and ejection nozzles on the outside of the ship. By this arrangement, therefore, the water which enters through the perforated bottom of the ship passes by way of the sluice valves into the wheel casing, and thence, by the action of the wheel, through the copper conducting pipes and out into the sea again from the nozzles at the end of the discharge pipes on the outside of the ship. The wheel is driven by three cylinders fixed round it at equidistance, each of the connecting rods being coupled on the one crank; one eccentric gives motion to each of the slide valves for the three cylinders. The cylinders are each 38½ inches in diameter, with a stroke of 3 feet 6 inches."

There was little to choose between the performances of the *Waterwitch* and her screw rivals, the *Vixen* and *Viper*, tried at the same time, and it was admitted that with certain modifications in the existing machinery of the first-named and the ejection nozzles, a much greater speed would no doubt be possible. It was also stated that with a suitably designed screw propeller a greater speed could have been obtained with the same power. Be that as it may, the experiment does not seem to have been repeated on so large a scale, and the improvements made in the steam engine soon outclassed completely the hydraulic propeller.

In Europe there was a disposition to disregard the power of the American ships, but when public opinion in this country and in Europe turned in their favour it went to the other extreme, and turreted ships with low freeboards were advocated irrespective of the totally different conditions prevailing on this side of the Atlantic. It was claimed that no turreted ship

with a low freeboard could possibly be a good sea-boat, or undertake an ocean voyage. The double-turreted monitor *Miantonomoh*, built at New York, in 1865, proved the contrary in the latter detail, when in 1866 she crossed the Atlantic under her own steam, in company with two other monitors, and visited some English and European ports. She was never tried in any engagement, but was considered by her designers to be superior to any vessel of the kind constructed for war both as a sea-going ship and for fighting purposes. Her armament made up in weight what it lacked in number. Each of her turrets contained two Dahlgren guns throwing projectiles weighing 480 lb., and she also had a 12 lb. howitzer. The turrets were 18 feet in diameter, and were protected by armour 11 inches thick. She did not, however, prove a good sea-boat, which is not to be wondered at when her low freeboard is remembered, and though she made the voyage in the summer months when the Atlantic is usually fairly calm, she proved very wet. However, her advent was quite sufficient to demonstrate to the European powers that she could make the voyage, and her novel appearance gave the impression that her fighting value was tremendous. When the American War was over the United States Government had no further need of a number of its vessels, and disposed of some of them, France buying two of the most powerful, and one or two other European powers were also purchasers.

Among the vessels France acquired was the *Dunderberg*, which was renamed *Rochambeau* by her new owners. It consisted of a long iron fortress mounted with guns to fire on the broadside and also ahead and astern. The hull, also of iron, was but little above the water, and the decks were iron-plated. The central portion had armour 7 inches thick with a heavy wooden backing, and the decks fore and aft of the fortress

were plated 8½ inches thick. Her two engines, developing 5,000 h.p., gave her at a pinch a speed of between eleven and twelve knots, but when she crossed the ocean she made the voyage under her own steam at between eight and nine knots. The after part, containing the screw propeller and steering gear, was also shot-proof. She had an immense beak or ram. Her total length was 378 feet, her breadth 73 feet, and her depth 31 feet, and she drew 22 feet of water.

As purchased by the French she had an armament of five 15-inch Rodman guns, and twelve 11-inch Dahlgrens. Another vessel, the *Onondaga*, was also purchased from America by the French, and both were altered at Cherbourg to meet French views.

When the French decided to adopt ironclad ships carrying a very few guns of great power, they did not hesitate to make some extraordinary experiments. One of their vessels, built in 1866, was the *Taureau*. It was like nothing that had been afloat before or has been launched since. Viewed from the stern, it resembled a sphere with a deck-house, a couple of masts, and a chimney. Much the same aspect was presented by a front view, except that before the deck-house was a small turret in which was one large gun. The turret was carried very far forward and could be revolved so that the gun had almost an all-round fire, the only limitation being the funnel and deck erections. The bow was extended enormously from the deck level to some distance below the water, and projected no less than 40 feet under the surface. The turret was not built on the deck, but descended to the bottom of the hold, and was protected by nearly 5 inches of armour, and a similar thickness was placed over the bows. The sides were plated 3 feet above the water-line, this belt extending to the stern. The engines were of 250 h.p. The *Taureau* was about 48 feet

maximum width, and 197 feet in length without the ram. The idea underlying the construction of this unwieldy ship was that she should be able to deliver a heavy shot at close range to an enemy's ship, and follow this up by ramming it, thereby completing its destruction; while her convex bows and circular turret would present no plane surface to the enemy, so that any shot which might strike it could only give a glancing blow and bound away harmlessly.

In 1862 another remarkable vessel called the *Magenta* was added to the French fleet. She was iron-plated and carried eighty guns on two decks, and in addition had a raised forecastle with ports on either bow, through which guns could be fired. She also had an immense blunt ram which projected like a cone upon the bows of the vessel and extended from the forecastle almost to the fore-foot. She presented an attempt to combine some of the features of the *Monitor* with the broadside ironclad, one American invention copied being the provision of a shot-proof tower just abaft the funnel for the accommodation and shelter of the officers during an engagement. She was barquentine rigged, and under sail and steam could get up a speed of about eight or nine knots.

The *Marengo*, another wooden ship which was plated with 8-inch iron armour, was designed to carry twelve guns. She had a central battery extending to the upper deck, and above this at each corner of the battery was an open armour-plated turret. The turrets each carried a large pivot gun, mounted *en barbette*, this being one of the first vessels France possessed in which it was sought to combine the advantages of the turret system with those of the barbette. These guns could fire in line of keel, and there were also four heavy guns on each broadside. She was 280 feet long by 57 feet 6 inches beam, and 28 feet draught, and was intended to have a speed of twelve

knots. Her rudder was on the balanced principle. The rigging was brought down inside the bulwarks, something after the fashion of some modern sailing ships, so as to present a clean side outside. All the French ships were broad for their length.

The first large armour-plated ship to enter the Pacific was the Spanish screw steam frigate *Numancia,* constructed at La Seyne by the Société des Forges et Chantiers de la Méditerranée. She was 317 feet in length by 57 feet 2 inches beam, and depth 37 feet, and her draught of water was 27 feet 6 inches, with a displacement of 7,303 tons, according to English measurement. She was built of iron throughout, and had 5 inches of armour-plate backed with 16 inches of teak from end to end of the ship, and from no less than 7 feet 9 inches below the water-line up to the level of the upper deck. Her armament was forty 68-pounders. She was built in less than two years, a piece of unusually quick work for a French yard, and was launched in 1864.

In 1868 the Dutch Government received from English builders two single turret ironclad monitors, intended for harbour defence, which were stated to be the first of the low freeboard type completed in this country, and carrying turrets on Captain Coles's system. These vessels, the *Krokodil* and *Heiligerlee,* were about 180 feet in length, with a beam of 44 feet, and a depth of 11 feet 6 inches. From the gunwale to 3 feet below the water-line they had iron armour-plates of a total thickness of 5½ inches, tapering off to 4½ inches at the extreme ends. This armour rested against a teak backing 10 inches in thickness, behind which was an inner skin of 1-inch iron, and inside this again was a series of longitudinal iron girders. For their size they were exceedingly strongly constructed, but as they were designed to be able to meet any

hostile vessel which might approach any of the harbours of the shallow Dutch coast where they might be stationed, the reason for such substantial construction is apparent. The turret armour was 11 inches thick at the gunports, and 8 inches thick elsewhere. The armament consisted of two 12½-ton rifled guns firing a 300 lb. projectile, which could be discharged from within four degrees of aft on either side to direct ahead. The turrets could be revolved by steam or hand power as desired. The twin-screw engines were of 140 h.p. nominal.

Another vessel of considerable interest, designed and built for the Dutch Government by Napier, was the turret gunboat *De Tygre*, which inaugurated a type which found much favour in Holland. This vessel, of 187 feet in length, 44 feet breadth, and moulded depth 11 feet 6 inches, and of 1,613 tons, builder's measurement, was built in compartments and with watertight doors, and was like most of the turret ships of the monitor variety, as she had a double bottom which could be filled with water to sink her to her fighting level. Thus only about 2 feet of her topsides would be exposed to the enemy. As an improvement upon her came another vessel from the same builders, which was described as "of a build which has long seemed to us as one of those most likely to become employed for the 'ship of the future,' not because she is a ram, but because she is essentially a sea-going turret ship." She was "the *De Tygre* over again, with the following exceptions: She has about 8 feet less beam, a rather greater draught of water, and light topsides are raised over the armour-plating and the deck, with which it terminates to the level of another deck; the vessel is thus in appearance an ordinary sea-going ship of war, for she is pierced for a few light guns on the lower deck; but her fighting strength consists in her turret, which is similar to that

of the *De Tygre*, except that the ports are at a higher elevation. This vessel is, therefore, a cruiser, unarmoured, higher than a level of 2 feet from the water; but practically for a fight at close quarters she is a monitor exposing only a turret and a low topside as parts vulnerable to shot."*

The Greek armour-clad *King George*, of 1,774 tons, built at Blackwall by the Thames Ironworks, was remarkable for the smallness of her dimensions in proportion to the strength and extent of her armour-plating. This was 6 inches thick, and had a 10-inch backing, and extended from the gunwale to 3 feet below the water-line, and from end to end of the vessel. She was 200 feet in length, and with engines of 2,105 h.p. indicated attained a speed of nearly fourteen knots on her trials. She was also notable for the peculiar arrangement of a central hexagonal box-battery on the Mackrow system for two 21-centimètre breech-loading Krupp guns (300-pounders), with the portholes so designed that the guns could be fired on both sides forward in line of keel, and nearly so aft; on the actual broadside the guns could be fired direct and parallel at the same time, or made to converge their fire at 70 yards distance from the ship's side, the racers being so placed that the guns pivoted from the muzzle and could each be trained over on the broadside, through an angle of 93 degrees, the front gun in this way pointing three degrees abaft.

In 1864 Germany made a start with its modern navy by ordering from Messrs. Samuda the cupola ship *Arminius*. One or two others were added, and then, in 1867, the powerful armour-cased screw frigate *Kron Prinz* was launched from the same yards. She was of 286 feet in length, and of 3,404 tons, builder's measurement, with engines of 1,800 nominal h.p. Her armour-plating extended entirely round the vessel from

* *The Engineer.*

6 feet below the water-line up to the main deck. The armour was 5 inches thick except near the ends where it was reduced to 4½ inches, and arrangements were made for the protection of the rudder and steering apparatus, as well as of the whole of the lower deck. The armour extended 14 feet upwards about 120 feet along each side, so as to protect the amidship battery, which was also protected by cross bulkheads. She was fitted with a considerable number of watertight compartments, a double bottom, and steel plating over the deck beams. She carried fourteen steel breech-loading guns of 7 tons each in her battery, a pivot gun on the deck at the bow protected by an armour-plated shield, and a pivot gun aft. Her iron lower masts served to ventilate the interior, and her lower yards were of steel; her speed was estimated at thirteen knots.

Apparently so well satisfied were the Prussians with this product of a British yard, that when the opportunity offered two years later to acquire one of the most powerful warships yet designed, they took advantage of it. There had been laid down at Blackwall for the Ottoman Government, a vessel designed by Mr. Reed, Chief Constructor to the British Navy, but Turkey, either seeing a profit in the transaction or being short of cash—deficiencies not being unknown in the history of Ottoman finance—permitted her, when about half finished, to be acquired by the Prussian Government. She was 365 feet in length, or 30 feet longer than the *Hercules*, with a beam of 60 feet, and a mean draught of 26 feet of water, with a burden of 6,000 tons. Her engines, by Maudslay, were of 1,150 h.p. nominal, and 7,000 effective. She was constructed on the longitudinal system, and within both frames and ribs was another iron skin an inch thick, making her a double ship, the inner one being 4½ feet from the other. The armour was 8 inches thick amidships, and tapering downwards to a thickness

of 7 inches to 7 feet below the water-line. It also tapered towards the bow and stern, diminishing from 8 inches to 6 inches. Under the counter or bows, where it was considered almost impossible a shot could strike, the armour was only 4 inches thick. But elsewhere there was never less than 6 inches of armour, besides the 10-inch teak backing and double iron skin. Aft of the bowsprit and forward of the stern were two heavy bulkheads, each of 6 inches of armour and 18 inches of teak, which were continued from the lower deck, through the main deck, and up to 7 feet above the spar deck, where they were curved to form shields, each pierced with four portholes for cannon and loop-holed for musketry. Within these shields were four Krupp's steel breech-loading 400-pounders, which could be fired forward or aft, or as broadside guns; and there were also twenty-three similar guns between decks. She was at that time the heaviest vessel which had been docked in the Thames.

Her new possessors evidently thought very highly of her, or they desired to pay her builders a compliment, for the German Government selected her to represent the German Navy at the Jubilee Review in 1887.

CHAPTER VII

ARMOURED SHIPS IN ACTION

When, in 1865, Spain deemed it necessary to give a lesson to her daughter Peru, whose victorious insurgents held views as to the non-payment of an indemnity, of which the mother country did not approve, she found that another of her offspring, Chili, sympathised with her sister, and it became necessary in Spain's opinion to extend the lesson to both States. The best warship she could supply for the purpose was the *Numancia*. This was a formidable vessel built for the Spanish Government in the 'sixties, at the time that relations were likely to be strained to breaking point between Spain and the two South American States. She was accompanied by some unarmoured vessels carrying about two hundred and fifty guns altogether, nearly all of which were old smooth-bores, the others being rifled guns of no great power. The Chilians had the *Esmeralda*, a small vessel having a complement of one hundred and twenty-three officers and men, and carrying eighteen smooth-bores of which the heaviest were 32-pounders. With this vessel they retaliated upon the Spaniards for their preliminary blockade of the Chilian ports by capturing, in November, 1865, the gunboat *Covadonga*, a somewhat similar boat to the *Esmeralda*, with two 68-pounders as her chief weapons. As usual, the Chilians shot well and the Spaniards shot badly, and the issue of the engagement was not long in doubt. The Spanish fleet distinguished itself by a cowardly bombardment of Valparaiso in 1866, notwithstanding its de-

fenceless condition, when, in spite of their wretched shooting, the Spaniards caused a great deal of damage, principally owing to the *Numancia's* guns. Valparaiso did not reply.

The Spanish fleet next tried Callao, which was fortified and gave the Spaniards more to think about than they cared for. The principal guns in the batteries were four Armstrong rifles, 300-pounders, which were in turrets faced with 10-inch armour, and five rifles of the Blakely pattern, firing 450 lb. shot. There were also several smaller smooth-bore guns. A small vessel of the monitor type, the *Victoria,* with one 64-pounder, and the monitor *Manco Capac,* with railway iron armour and two 68-pounders, constituted the Peruvian fleet. The *Numancia,* at 1,500 yards range, led her consorts to the attack, but in about half an hour the *Ville de Madrid* was placed *hors de combat* with a shot in her steam-pipe. The next disaster to the Spaniards was when the *Berenguela* had a hole blown in her side by a Blakely shell, so that she could do no more fighting. Then two more Spanish ships had to retire, as they had fired away all their ammunition. The *Numancia* was hit repeatedly, but her armour saved her from serious damage. The smaller projectiles did her no harm at all, but one of the shells from an Armstrong gun went through her plating and was prevented by the backing from going farther. Both sides lost heavily, but notwithstanding the amount of ammunition expended the damage was not very extensive. This time the honours were distinctly with the shore batteries, and the Spaniards sailed for home.

That the advantage given by the possession of powerful warships may be entirely neutralised was demonstrated by the Brazilians in their conflict with Paraguay, in 1865. The Paraguayans fought with the energy of despair. They were between the devil and the deep sea, for they knew that if they

did not conquer their enemy, their commander would reward them with tortures from which death would give them a welcome release. In these circumstances the Paraguayans displayed extraordinary daring with a by no means adequate fleet for resisting the Brazilians, who were allied with Uruguay and the Argentine republic, as the outcome of the Paraguayan president, Francisco Lopez's, energetic, if unconventional, methods. During this war the *Cabral* and *Colombo* were added to the Brazilian fleet from Thames builders. They were each 160 feet long and drew 9 feet 9 inches when loaded, and with two pairs of direct-acting horizontal engines of 200 h.p., each driving a screw propeller, so that they were twin-screw boats, they could attain a speed of ten and a half knots. They were really oblong iron forts, supported on rafts. There was no central battery, but each vessel carried six guns forward, two being disposed in the front of the citadel and two on either side of the fore part. A similar battery was placed at the other end. The armour-plates were 4½ inches in thickness, and the deck before and abaft the battery gradually sloped all round to the water-line, and being covered with 2½-inch armour-plating, prevented a shot from penetrating into the ship. The arrangement of the guns enabled these vessels to be fought either end on, or on the broadside. Each was armed with twelve 70-pounder Whitworth guns. Two other powerful vessels were also built for Brazil at Birkenhead. One of the oddest naval encounters on record was fought in March, 1866, between a powerful Brazilian fleet and a Paraguayan vessel. The Brazilians had three of these ironclads, a single-turreted monitor, and several wooden ships. The Paraguayans opposed this armada with a barge mounting an 8-inch smooth-bore gun. The firing was fast, furious, and inaccurate. The smooth-bore made good practice. The Brazilians hit everything in range for

some time except the one-gun barge. By dint of perseverance they struck it eventually and sunk it.* This glorious naval exploit was followed by another piece of daring, in which the Brazilian fleet engaged in a more or less uninterrupted encounter for three weeks with a fort mounting one gun ; the fleet won.

The last quarter of the nineteenth century saw not a little warlike activity in one part of the world and another in which the navies of the contestant powers were conspicuous. The naval engagements in the Russo-Turkish War were mainly remarkable for the regularity with which the Turkish warships were blown up by the Russians, the daring of Russian officers in making attack after attack, and the apparent disinclination of the Turkish officers to take adequate means to protect their vessels. Had the Turks been as vigilant as the Russians, the latter would hardly have scored so many brilliant successes.

The South American Republics, too, were indulging in one of those periodical bursts of unrest and pugnacity which seem inseparable from South American States in their relations with each other, or in the administration of their internal affairs, and when carefully fomented may lead plotting politicians on to become dictators and the victims of assassinations—unless they are fortunate enough to retire to Paris with the spoils and live in luxury and die naturally.

One of these revivals of political ferment brought the *Huascar* into prominence, and made her for some years the most famous fighting ship in the world. The interest taken everywhere in the doings of this ship was extraordinary. She was launched in 1865 at Birkenhead, from that yard which has sent so many ships to sea to make history, and if local associations have their influence over ships, and sailors say

* " Ironclads in Action," by H. H. Wilson.

they have, the records of the *Huascar* show that she was not false to tradition. Built to the order of the Peruvian Government, she was a turret ship of 1,800 tons displacement and eleven knots speed, and carried a belt of armour on the waterline of from 4½ inches thick at the centre portion to 2½ inches at the ends. Her one turret, which was placed rather forward of amidships, was built on Captain Coles's design, and given 5½-inch iron plates. In it she carried two 10-inch 12½-ton Armstrong muzzle-loaders; and on her decks were two 40-pounders and one 12-pounder, all three being muzzle-loaders and unprotected. Her lower foremast was on the tripod system, but this was afterwards discarded and she was given an ordinary mast. She had a main- and mizen-mast also, and all three carried topmasts and square sails; when her masts were altered a military top of iron plates was built upon the cap of the mainmast.

She had a most exciting career. Her crew mutinied and put to sea in her, and took to freebooting quite in the spirit of the old days of the Spanish Main and the South Eastern Pacific. She was declared a pirate. At the end of May, 1877, the British cruisers *Shah* and *Amethyst*, which had been ordered to look for her, discovered her off Ilo. These were both light unarmoured cruisers, the latter being much the smaller of the two, and depended largely upon their speed to render attack upon them more difficult, or to avoid it altogether, or to assume the offensive at a time best suited to themselves. Their guns were more modern and powerful than those of the *Huascar*, and also more numerous, so that in gun power the cruisers were superior to the ironclad.

This engagement is noteworthy for the reason that in it the first automobile torpedo ever employed in war was discharged by the *Shah* against the *Huascar*, and failed to reach

its mark. The *Shah* bore the brunt of the engagement with the *Huascar*. The latter almost ignored the *Amethyst*, whose small guns did no more harm to her sides than a mosquito would do to an elephant, but helped to make the mutineer's deck guns useless, and the ironclad reserved her attention for her more formidable antagonist. Whenever the firing became unpleasantly severe, as it frequently did, the *Huascar* steamed in front of Ilo, and the *Shah* then hesitated to fire lest her shells should miss the *Huascar* and hit the town, notwithstanding that the *Huascar* then fired at the *Shah*. But the *Huascar's* aim was faulty, partly because of the poor shooting powers of her gunners, and partly because the *Shah* kept rapidly on the move and so presented no steady mark to the Peruvian gunners. The *Huascar* tried to ram her, but the *Shah's* speed enabled her to avoid the blow without difficulty, and give a telling shot at short range in return. Altogether the ironclad was hit nearly seventy times, but though she was badly dented, only one shell passed through her 3-inch armour to a sufficient extent to cause any injury to the interior of the vessel or to her crew. The hulls of the British ships were not struck once, though their rigging suffered a little trifling damage. They hoped to capture the *Huascar* on the morrow, but by daylight she was out of sight, and during the morning was surrendered by her commander to the Peruvian Government ships. But her fighting days were by no means over. This battle was held by the experts in naval matters to demonstrate the value of armour and the weakness of the ordinary 9-inch muzzle-loader, and also the prime necessity of accurate shooting. The English gunnery was bad and that of the Peruvians was execrable.

When Chili and Peru indulged in a war in 1879–81, the latter country owned the *Huascar* and the *Independencia*. The

latter was an armoured vessel of 3,500 tons, built in England in 1865, and occasionally confused with the other *Independencia* built on the Thames a few years later for another South American State, but which passed into the possession of the British Government. The Peruvian *Independencia* carried two 150-pounders, twelve 72-pounders, and four 30-pounders, all muzzle-loading rifled guns, and for this war her fighting power was strengthened by the addition of a 9-ton gun and a 150-pounder. The *Huascar* had been reboilered since her fight with the *Shah* and the *Amethyst*. The Peruvian navy was a fairly formidable fighting fleet, but what it displayed in this respect was more than neutralised by the inefficiency of its personnel who, however brave individually they may have been, sadly lacked order and control. The Chilians included in their fleet two modern powerful ironclads, the *Blanco Encalada* and the *Almirante Cochrane*, both of which were built in England in 1874–5. Each was of about 3,500 tons, and designed on the central box battery plan, and as will be seen from the accompanying particulars of the *Almirante Cochrane*, both vessels were exceedingly formidable fighting ships. The *Blanco Encalada* also had two Nordenfeldts and the *Almirante Cochrane* one.

The *Almirante Cochrane* was 210 feet in length on the water-line, with a breadth of 45 feet 9 inches, and a depth of hold of 21 feet 8 inches; and in fighting trim she drew 18 feet 8 inches of water forward and a foot more aft. Her whole length in the neighbourhood of the water-line was protected by a stout belt of armour and teak backing 8 feet wide, with the armour-plates 9 inches thick at the water-line and the teak backing 10 inches. The battery was amidships, and was armed with six 12½-ton Armstrong guns. The whole of the armour and backing was fastened to a double thickness of skin

plating by bolts similar to those used in the British Navy. She was the first ironclad built at Hull.

With the three guns on each side she was able to fire over all the points of the compass, this advantage being attained by placing each of the fore and aft guns at the corners of the battery, and recessing the side of the ship so as to enable the foremost guns to fire right forward and in a line with the keel, and in like manner the after guns to fire right aft. The batteries being octagonal, the corner guns could be brought into the broadside position and command any single angle between that and the line of keel. The midship guns on each side were made to fire on the broadside, and also to support the fire of the forward guns up to within 20 degrees of the line of keel.

It is unnecessary to describe the naval manœuvres preparatory to the meeting of the hostile vessels, or to deal with the causes of the war.

The *Huascar* very nearly blew herself up instead of her antagonist, the *Abtao,* off Antofagasta. She fired a Lay torpedo at her, but the missile turned and headed straight at the *Huascar,* whose turbulent career would most likely have been ended there and then had not one of her lieutenants dived overboard at the torpedo and diverted it so that it missed the warship by a few inches.

As soon as the Chilians heard that the Peruvian fleet had come south, the former left the historic *Esmeralda* and another wooden ship, the *Covadonga,* which was equally slow, behind at Iquique, and went to look for the Peruvian ships. The latter slipped past in the darkness and sent the *Huascar* and the *Independencia* to smash up the two wooden ships left behind to blockade Iquique. The *Huascar* attacked the *Esmeralda* and the *Independencia* endeavoured to account for the *Covadonga.* Thus, two modern powerful ironclads were opposed to two old

wooden ships indifferently armed and painfully slow. On the face of the paper statistics the battle should have lasted four minutes; as it was, it lasted four hours. As soon as the Peruvians on shore saw that the *Esmeralda* and the *Covadonga* were to be attacked by the two Peruvian ironclads they opened fire on the blockading ships and compelled the *Esmeralda* to seek a less favourable position. The *Huascar*, seeing this was a suitable moment, tried to disable her with the ram, but inflicted very little injury. Before this a shell from the *Huascar's* turret gun pierced the *Esmeralda's* engine room, killing all the engineers and disabling the engines so that for a time the wooden ship was helpless. But the Chilians patched up the engines and got them going again. This one shot from the *Huascar* was probably due to good luck rather than good shooting, for although she hit once with her turret gun she missed thirty-nine times. The *Esmeralda*, on the contrary, hit the *Huascar* repeatedly, but her smaller projectiles were harmless against the iron armour, and inflicted no damage to the hull, but the careful firing of the Chilians rendered it very difficult for the *Huascar's* crew to expose themselves in any degree on deck for working the other guns. The *Huascar* again rammed the *Esmeralda*, this time on the starboard bow, and the Chilians with extraordinary bravery attempted to carry the ironclad by boarding it, but in the confusion the order to board was not understood, and the attempt consequently failed. Again the *Huascar* rammed, now making a great gaping wound in the side of her feeble opponent, through which the water rushed and caused her to founder in a few minutes. She went down with her colours flying, all her wounded on board, and nearly all the rest of her crew.

The other duel, between the *Independencia* and the *Covadonga*, was of a very different nature. The Chilian boat had an English

pilot on board and determined to effect by strategy what she could not accomplish by force. She went away along the coast, keeping in the shallower waters, pursued by the *Independencia.* The *Covadonga* at last found herself near the reefs, touched a rock and stopped, but did not remain fast. The *Independencia,* which was only 200 or 300 yards behind, thought that this was a grand opportunity to ram her, and not knowing the reason of the *Covadonga's* sudden stoppage, headed straight for her. Instead of striking the *Covadonga,* she ran on the reef with all her force, and remained hard and fast. The smaller wooden boat then steamed into a favourable position astern of the ironclad where the latter could not bring her great guns to bear, and at short range poured shell after shell into her stern until it was soon blazing fiercely. During the pursuit of the *Covadonga* the two vessels had exchanged several shots. As usual, the Peruvian gunners, who were untrained, missed nearly every time, and the Chilian gunners, who shot carefully, seldom failed to do damage. This ended the career of the *Independencia.* The *Covadonga* was sunk by Peruvian torpedoes in September, 1880, off Chancay.

The *Huascar's* next exploit was in 1879, when she fought the *Almirante Cochrane* and the *Blanco Encalada.* The *Huascar* opened fire at 3,000 yards range but inflicted no injury. The *Cochrane* steamed in and replied at 700 yards with a broadside which made the ironclad shiver from stem to stern, for every shot struck. The *Huascar* was no match for either of these vessels and certainly not for them both, but she fought on with a grim determination which has made this engagement one of the most memorable on record, and has caused more than one historian to compare it to the famous fight of Sir Richard Grenville's little *Revenge,* when that intrepid adventurer tackled a Spanish fleet numbering fifty-three vessels, and did

not surrender until he himself and nearly all his crew were wounded, and most of the others killed, and his ship was like to sink under him.

The punishment the *Huascar* received in this engagement was extraordinary. No fewer than twenty-seven of the heaviest projectiles fired by her opponents struck her, thirteen of the blows being severe. Two of the large shells went through her turret armour and exploded. Three others struck her conning tower. Her 'tween decks was turned into a shambles, and almost wrecked by the explosion of five heavy shells. Three times was she hit severely in the stern. The battle was fought at close range and the force of the blows inflicted must have been tremendous. Under the rain of shot and shell the wonder is that the *Huascar* remained afloat. Had the Chilian shooting been better it is doubtful if she could have survived. The *Almirante Cochrane* fired forty-five 9-inch Palliser shells, and twelve 20-pounder shells, besides a great number of smaller projectiles; and the *Blanco Encalada* delivered thirty-one heavy shells. The *Huascar* fired about forty shells, but could do little damage to her formidable antagonists. The *Cochrane* was hit three times, but did not sustain much injury, and the *Blanco Encalada* escaped practically unhurt. After her surrender, the *Huascar* was patched up by the Chilians, and when she was fit to go to sea again and look for more fighting she flew the Chilian flag. Under her new owners she captured a small gunboat and participated in the blockade of Callao. She was on the effective list of the Chilian navy up to a year or two ago, and is now passing to the scrap-heap by slow and dignified stages.

In the fighting off Valparaiso in April, 1891, during the Chilian Revolution, the *Blanco Encalada* stopped a tug called the *Mary Florence* and a torpedo boat from leaving the harbour, and the two latter, which were Government vessels, were so

hotly fired upon that they were glad to return. A heavy shot from the *Blanco Encalada* struck the *Mary Florence* and blew her out of the water, killing the seventeen men who constituted her crew. The torpedo boat held on, but the other insurgent vessel, the *O'Higgins,* knocked her into pieces with a well-directed broadside, and her crew shared the fate of that of the *Mary Florence.* The *Blanco Encalada* and *O'Higgins* then turned their attention to the forts, and a lively battle followed. Although it was dark some good shooting seems to have been made, for the forts at last had the range of the *O'Higgins,* and a heavy shell struck one of the guns on her quarter-deck. The explosion shook her from end to end, and when the smoke cleared away it was found that her deck was almost torn to pieces and the gun itself was lying on the other side of the deck, while nine of the gun's crew of twelve were either killed or blown into the water and drowned. The *O'Higgins* was immediately taken out of range, but the *Blanco Encalada* kept up the fight for a time without being any the worse and then retired to look after her consort.

After they had gone, the rebel man-of-war *Esmeralda,* which must not be confounded with the wooden vessel of that name, opened fire on the town while the inhabitants for and against the Government were having a pitched battle in the streets. The Government forces got the worst of the fight, and the *Esmeralda* took in a supply of coal and provisions, and steamed away to join other insurgent vessels.

This *Esmeralda* was designed and built by Armstrong, at Newcastle, in 1884, for the Chilian Government, and is of more than ordinary interest, as she was the first example of the modern protected cruiser class. She was framed on the ordinary transverse system, and had three decks ; the upper, or gun deck, was 11 feet above water, the main deck about

5 feet, and the lower, or arched protective deck, which was of 1-inch steel and extended from stem to stern, was at the middle 1 foot below water-level, and at the side 5 feet. It protected the engines, boilers, magazines, and all the vital parts. Minute sub-divisions of the hold space below the protective deck and of the space between it and the main deck were effected by means of transverse and longitudinal bulkheads and of horizontal flats or platforms; cork was also packed in the cellular spaces to ensure sufficient buoyancy and trim in case the water-line region should be riddled. Her twin screws were driven by two independent sets of 2-stage expansion engines, developing 6,500 h.p., which gave her a speed of 18.25 knots. She had four double-ended boilers, 13 feet diameter and 18½ feet long, working at 90 lb. pressure, each with six furnaces supplied with forced draught. Her bunker capacity was 600 tons, sufficient for eight thousand knots at a speed of eight knots, or six thousand knots at ten knots. Her armament was two 25-ton 10-inch breechloading rifle guns, protected by steel screens, and having a training arc of 120 degrees on either side of the keel; six 4-ton 6-inch breech-loading rifle guns; two 6-pounder quick-firers, and a number of machine guns, as well as three torpedo tubes. Her two military masts had a Gardner gun in each. Her displacement was 3,000 tons, her length 270 feet, her breadth 42 feet, and her draught of water 18.5 feet.

On the morning of May 23rd, before daylight, the search-light of the Government torpedo gunboat *Almirante Condell* revealed in the distance the presence of the *Blanco Encalada*. The torpedo gunboat had the *Almirante Lynch* as companion, and the pair lost no time in attacking the ironclad, which was at anchor with banked fires, as part of her machinery was ashore undergoing repairs. The *Condell* opened the ball with her

torpedo, which missed, and followed it with discharges from her Hotchkiss gun. The *Lynch* also brought her Hotchkiss gun into play, and as both vessels were firing end-on, they presented a very small target to the ironclad, upon which, however, they could make little impression. The *Blanco Encalada* answered the fire, but ineffectively. The torpedo boats, attacking her from different sides, discharged five more torpedoes, which missed, and though the ironclad was firing carefully, the steel armour of the smaller vessels turned aside her shot and shell. At last a shell from the ironclad dropped on the *Condell,* doing a great deal of damage. The *Lynch's* Hotchkiss gun played havoc with everything and everybody on the *Blanco Encalada's* deck and above it.

"The officers of the *Lynch* now determined to make a supreme effort. Her flag was run up to the peak, and her Hotchkiss gun became silent. She worked round until she was bow on to the starboard side of the *Encalada,* and then there was a swish from the tube of the *Lynch's* ram. The *Encalada* got her search-lights on the approaching missile, as she had on the other four, her gunners poured a leaden rain on to it for the purpose of sinking it. This, time, however, the aim of the torpedo was true, and the storm of shot from the *Encalada* failed to destroy it. The steel torpedo net also failed to avert the messenger of destruction, so sudden and unexpected was the attack. The torpedo struck the *Encalada* just abaft the foremast, and a deafening explosion followed. A huge hole yawned in her starboard side, extending below the water-line, and the ironclad quickly filled. Terror reigned on board the doomed ironclad, and the men scrambled into the boats hanging upon the rear davits, which were the only ones which had not been destroyed by the fire of the guns. Both the *Condell* and the *Lynch* now opened fire from the Hotchkiss guns, and scores of men were killed while attempting to escape. Many of the sailors sprang into the water, only to meet death by drowning, or being eaten by sharks, with which the bay abounds. The ironclad

quickly settled and, with a sudden lurch, went down in less than three minutes, with her officers and crew. Out of two hundred men, only twelve escaped."*

The naval proceedings in the Franco-Prussian War in 1870–1 remind one somewhat of Sir Richard Strachan and the Earl of Chatham, each of whom, according to the well-known verse, had his sword drawn and waited for the other. In the Franco-Prussian conflict, however, there was a hostile meeting at sea, although on a small scale. The only naval action in this war was that between the French gunboat *Bouvet*, carrying one 16-centimètre gun and four 12-centimètre guns, with a complement of eighty-five officers and men, and the German gunboat *Meteor*, with one 15-centimètre gun and two 12-centimètre guns, and having sixty-four officers and sailors. They met at Havana, and left the harbour for the open sea at the prescribed interval. When outside territorial limits they exchanged cannonades for two hours at 1,200 yards range, with little harm to either. Then the Frenchman decided to ram, but the *Meteor* moved and only received a glancing blow which did little damage to her hull but brought down her main- and mizen-masts. The *Bouvet* was going to ram again, when the *Meteor* gave her a solid shot in her boiler. There was no further fighting, for the Spanish ship which had steamed out from Havana to prevent a violation of neutrality, informed them that they were now in Spanish waters and that the engagement must stop.

The Turkish fleet at the beginning of the war with Russia in 1876–7 was superior to that of Russia in every respect save efficiency. The Russian Black Sea fleet, owing to diplomatic restrictions, was of very little use. The only effective naval work performed by the Russians in this war was with torpedo

* Valparaiso letter to *New York World*.

boats brought overland by rail from the Baltic, which were supported by merchant steamers acquired for the purpose. The Turks had some splendid vessels which should have given a good account of themselves, and had they performed the duties expected of them and of which they were quite capable, and had they been properly handled, the history of that war would have been very different. When the Turks lost command of the sea they also lost the war. One of their finest vessels was the *Messoudiye,* a sister ship to the British *Superb,* which had also been built for the Turkish Government, but was bought by England. Both were of 9,100 tons displacement, and had engines giving them a speed of thirteen and a half knots on 1,200 h.p. They had 12-inch armour with a 10-inch backing, and carried sixteen 10-inch guns. The Turks also had four vessels of over 6,000 tons displacement, the *Azazieh, Mahmoudieh, Orkanieh,* and *Osmanieh ;* the *Assar-i-Tewfik,* of 4,000 tons, each having fifteen 6½-ton guns and one 12-ton gun ; and several smaller vessels. These were all broadside or central battery ships. There were also a couple of monitors with turrets, and some armoured gunboats, among which were the *Avni-Illah,* of 2,314 tons displacement, a more powerful version of the Greek *King George.* Some of the ships had officers trained in the English Navy, and there were also a few English officers serving with the Turkish fleet. The vessels on which these officers were engaged were managed as warships should be, but those which were left to the tender mercies of the Turkish officers were sadly neglected, and discipline on board was conspicuous by its absence. This was one reason why the Russians were successful so frequently in their surprise attacks. Then, when they were disagreeably aroused to the presence of the enemy the Turks usually distinguished themselves by shooting very wildly and widely, and before they

knew what they were about the Russians had dashed in and torpedoed the Turkish ship. In spite of the preponderance of Turkish ships, they only came to close quarters once with a Russian ship, and that was a converted merchantman. It is probably a good thing for the Turks that the Russian naval force was so weak, for had it been stronger the Russians would not have hesitated to attack the Turks, and when the attack was over there would probably have been a repetition of the story of the Battle of Sinope and the destruction of the Ottoman fleet which preceded the Crimean War. The ships under English officers would have given a good account of themselves, especially with such men as Hobart Pacha in command; as it was, the English did their best, but their efforts were negatived by the incompetence and indifference of their Turkish colleagues.

The Turkish warships on the Danube began the roll of Ottoman naval disasters in this war, the first to be lost being the *Lutfi Djelil*, launched at Bordeaux in 1868. She was engaged with a Russian battery at Braila, during the attack on the Turkish squadron, and the engagement was proceeding fiercely when a shell struck the vessel and blew her up. As torpedoes and mines were also being employed by the Russians her destruction has sometimes been ascribed to one of these.

The Russians seem to have had very little difficulty in approaching the Turkish ships, owing to the negligent way in which the sentries kept a look-out, and their daring was certainly rewarded by a remarkable series of successes in which the luck was unquestionably on their side. Thus at the attack on the *Seifi* the latter's turret guns missed fire three times, and the Russians got so near that they blew a hole in her by pushing a Whitehead torpedo under her stern, and exploded another near her bows in order to hasten her disappearance beneath the waters of the Black Sea. Possibly

one reason why the Turks generally missed the Russian torpedo boats when they aimed at them was that there were no quick-firers, as the term is now understood, and that the Turks had nothing between the clumsy and heavy 40-pounders and the Gatlings, and had no guns to meet the torpedo attacks, even when they did sight the approaching torpedo boats. Another reason why they failed to prevent the attacks by gun-fire was the great difficulty of training heavy guns upon small fast-moving boats no bigger than steam launches upon the dark and inclement nights which were usually chosen for the enterprises. Again, the slow-firing guns of those days had to be laboriously reloaded afresh and aim had to be taken again, and by that time the attacking boat might be out of range or have discharged its dangerous and destructive missile.

The one ship-and-ship encounter of the war took place between the converted merchant steamer *Vesta* and the Turkish *Assar-i-Chevket*. The latter gave chase and steadily overhauled the other until those on the *Vesta* began to expect that another few minutes would see her career brought to an end by the warship overtaking and ramming her. Both ships had been making good shooting, especially the Turk, but at the last minute a heavy shot from the *Vesta* struck the warship's conning tower a hard blow, and the warship gave up the chase.

Many of the British ironclads, the development of which has been traced in earlier pages, participated in the bombardment of Alexandria, in July, 1882. The Egyptian fortifications mounted a great variety of guns, intended, it was unkindly suggested at that time, to meet on equal terms all kinds of floating craft from ships' gigs to battleships. The forts were provided with a number of heavy Armstrong and Krupp guns of great calibre and immense power. These included five 10-inch 18-ton guns, eighteen 9-inch, and fourteen 8-inch guns,

DUEL BETWEEN THE "VESTA" AND "ASSAR-I-CHEVKET."

From a contemporary Italian print.

RUSSIAN TORPEDO BOATS ON THE DANUBE IN THE RUSSO-TURKISH WAR

all of which were rifled. The majority of the guns in the forts were indifferently mounted, to a large extent through carelessness in the work, and some of the latest pattern had been so recently delivered that there was no time, as time is reckoned in the East where a few months seldom matter, to mount them at all. No doubt they had been intended to supersede the old, small, smooth-bore guns of which the forts had enough and to spare, there being no fewer than two hundred and eleven of them, but as this work had not been done the Egyptian gunners had to make shift as best they could with the guns in position. There were also thirty-eight mortars. Of course, under the circumstances many of their projectiles failed to reach the British vessels at which they were aimed. The Egyptian gunners also served their weapons very badly, and even when the British ships were within short range of the heavier guns, nearly every shot missed its mark. The forts appeared from the outside to be much better constructed than they really were, and their magazines, though extensive, were by no means the safe places they should have been for the storage of ammunition and projectiles, and in this probably lies the explanation of the blowing up of some of the forts. The heavier Egyptian guns were fired through embrasures, their gunners being thus afforded a considerable measure of protection; but most, if not all, of the smooth-bores were fired over parapets, so that they were more exposed to the fire of the ships.

The disparity in gun power between the fleet and the forts was so great that the view was confidently expressed in England that if hostilities should ensue the forts would be reduced in anything from half an hour to a couple of hours. Yet for eleven hours the Egyptian gunners maintained the unequal combat. Had their skill been equal to their determination,

Alexandria had not fallen so easily and with so little damage to the British ships.

The ironclads were the *Inflexible,* firing a broadside of 6,880 lb. from her four 81-ton guns; the *Temeraire,* 8,540 tons, four 25-ton and four 18-ton guns; the *Superb,* 9,100 tons, with four 25-ton guns, and a weight of broadside of 3,280 lb.; the *Alexandra,* 9,490 tons, two 25-ton and ten 18-ton guns; the *Monarch,* 8,230 tons, four 25-ton and two 6½-ton guns; the *Invincible,* 6,010 tons, ten 12-ton guns; and the *Penelope,* 4,394 tons, ten 12-ton guns. All these vessels carried a number of smaller guns as well. The gunboats were the *Beacon, Bittern, Cygnet, Condor,* and *Decoy,* and there was also a small despatch boat.

The *Monarch, Temeraire* and *Penelope* attacked Fort Meks and Fort Marsa-el-Kanit on the mainland; and the *Superb, Sultan* and *Alexandra* opposed the Lighthouse and Pharos forts. The *Inflexible* co-operated with either squadron as required. The Marabout batteries at the entrance to the harbour were left to the five gunboats. These were each armed with a 4½-ton 7-inch rifled Woolwich gun and two 64-pounders, all muzzle-loading. The Marabout forts were protected by two 18-ton guns, two 12-ton guns, twenty 32-pounders, and five mortars. This fort had been constructed in such a manner that the guns could not be trained to fire below a certain angle, and consequently any vessel which could get within this angle would be comparatively safe from the fire of the forts, and with the superior training of its guns could shell the forts at short range with terrible effect.

Lord Charles Beresford, the commander of the *Condor,* saw this, and determined to make the effort. With magnificent daring and consummately skilful handling of his small vessel, he managed to get her through the zone of fire without receiving

a shot in return, thanks to the erratic firing of the Egyptian gunners. Having got under the angle of fire the *Condor* began to use her guns with terrible effect.

A certain gun in the Marabout fort was annoying the attacking flotilla very seriously, and in spite of the efforts of the assailants they could not suppress its fire entirely. One man at this gun proved that he was an excellent marksman and sent several shells dangerously close to the ships.

The story goes that this particularly obnoxious Egyptian gunner was noticed by Lord Charles Beresford, who ordered his own best gunner to knock over the Egyptian gun. This was no sooner ordered than done, but the Egyptians worked hard and mounted the gun again, and once more the Egyptian gunner was seen to be in charge of the piece.

"Hit that gunner," Lord Charles commanded.

"Yes, sir. Where shall I hit him?" the gunner asked.

"Hit him in the eye," was the reply of the future admiral.

"Which eye, sir?" asked the gunner. But before the commander could indicate any preference as to the particular Egyptian optic which should be hit with an explosive shell, the gunner had fired, and the shot took off the man's head.

The *Condor* maintained her duel with the forts for an hour and was not hit seriously once. Almost single-handed she silenced the great guns of the Marabout fort, and afterwards aided the *Bittern* and *Cygnet* to suppress the other guns. Little wonder was it that when she afterwards passed the *Invincible* she was rewarded with the splendid compliment, "Well done, *Condor*." The crews of the large warships cheered her as she passed them, and her own crew returned the compliment, not forgetting cheers for their popular commander and groans for Arabi Pacha.

Meanwhile the *Inflexible*, with her terrible 81-ton guns,

was steadily if slowly firing at the Meks and Lighthouse forts. The guns of one turret sent shell after shell into one of the forts and those of the other turret were directed upon the other fort. The heavy rumbling of her immense shells contrasted curiously with the scream of the lighter shells of the smaller guns. Her enormous projectiles, weighing about 1,700 lb. each, fired with terrible precision, blew the face of Fort Ada to pieces, and aided in reducing the Lighthouse fort.

The bombardment was a repetition of the old story of fixed shore fortifications being assailed by a mobile and powerful fleet. As usual the fleet could manœuvre to its own best advantage for shelling an enemy and upsetting his aim. The fleet itself, however, did not escape entirely without injury. A shell entered the captain's cabin of the *Alexandra* and burst, doing considerable damage to the contents of the apartment, but singularly little injury to the ship. The *Alexandra's* armour was pierced several times, but none of the projectiles succeeded in getting through the backing, and a portion of her smokestack was shot away. Altogether she was struck twenty-five times. Most of the other attacking vessels also bore marks of the engagement, but in no instance was the injury inflicted serious. Much of the damage was sustained aloft, thus showing that the Egyptian gunners had for the most part aimed too high. Some of their shells, also, failed to explode, and on the whole the firing from the forts was badly directed. The British had five men killed and twenty-eight wounded. The losses of the Egyptians were never known accurately, but must have been very great, for the British shells which did not hit the forts found their billets in the town behind and, exploding, added to the terror and death-roll among the natives who had not already fled.

A correspondent who visited the forts immediately after the bombardment wrote :—

"One is amazed at the destruction accomplished which was not visible from the sea, and at the bravery of the Arab gunners in remaining at their posts so long. The number and variety of their guns are surprising and the stock of projectiles and ammunition is immense. If they had had more men and been well commanded, the fleet would have had a very warm reception. In one fort we counted several 18-ton guns, 19-inch Armstrongs. In another four 9-inch and one 10-inch Armstrong; in another two 15-inch smooth-bores . . . besides 40-pounder Armstrongs and any number of old 32-pounders. . . . One small battery gave the ships a great deal of trouble . . . it was effectually silenced at last, every gun being knocked off the trainings. At Bab el Meks some Armstrongs were knocked down, others were hit up with muzzles in the air, and embedded in one gun we found shots from a Gatling."*

The present United States navy may be said to date from 1883. After the close of the rebellion the American Government had no further need of the majority of the war vessels built or improvised for that struggle, and having sold some, neglected nearly all the remainder. America and Spain almost came to blows over what was known as the Virginius affair, and the great republic prepared to do its best on "the mobilisation in southern waters of a fleet which consisted in great part of antiquated and rotting ships."† The United States also sadly missed the possession of an efficient navy when serious differences arose with a powerful European state over the right interpretation and application of the Monroe Doctrine to the Panama Canal and the control thereof. Both these events, supported by the Ten Years War in Cuba and the unconcealed American sympathy for the Cubans, prepared the country

* *Daily News.*

† "The New American Navy," by Ex-Secretary of the Navy, John D. Long.

for the acceptance of the dictum that a more modern navy was necessary, and this was emphasised when it was announced during the administration of President Rutherford B. Hayes that the navy of any European power was superior to that of the United States, and that even Chili, with the *Almirante Cochrane* and the *Huascar*, would be able to bombard San Francisco and that the United States Government had not the means to prevent them.

In order to appreciate the enormous progress which the United States have made as a naval power in the past thirty years one must turn to the American Navy List for 1879, and compare it with the present equipment in the matter of ships and personnel, which places the United States in the position of being the second naval power of the world—second, indeed, only to Great Britain, and with resources for the production of warships of the latest design and the highest fighting capacity scarcely if at all inferior to those of the United Kingdom itself. In 1879 there—

"Were five steam vessels classed as first-rates, which had been built twenty-five years before and were then obsolete and practically useless as men-of-war; twenty-seven second-rates, of which three lay on the stocks, rotten and worthless, seven were in ordinary unfit for repair, and only nine were actually in condition for sea duty; twenty-nine third-rate steam vessels, of which fifteen only were available for naval purposes; six fourth-rate steam vessels, none of which was of account as a warship; twenty-two sailing vessels, but five of which could even navigate the sea; twenty-four ironclads, fourteen of which were ready for effective service; and two torpedo vessels, one of which was described as rather heavy for a torpedo vessel, not working so handily as is desirable for that purpose, and the other, known as the *Alarm*, was in the experimental stage. . . . In the entire navy there was not a single high-power, long-range rifled gun."

Of the bravery of the American sailors of whatever rank there has never been any question, but the methods of selecting them seem to have been as peculiar as the British methods of corruption in the old days, when it was possible for an infant in arms to be on the pay roll of a British ship when he had never so much as seen the sea, to say nothing of never having been on board the vessel of which he was nominally a midshipman.

The following racy account,* which illustrates the American system of the past better than any lengthy description could do, of the examination of Midshipman Joseph Tatnall, a relative of the famous American officer of "Blood is thicker than water" fame, will be read with interest in this connection :—

Commodore : Mr. Tatnall, what would be your course, supposing you were off a lee shore, the wind blowing a gale, both anchors and your rudder gone, all your canvas carried away, and your ship scudding rapidly towards the breakers ?

Tatnall : I cannot conceive, sir, that such a combination of disasters could possibly befall a ship in one voyage.

Commodore : Tut, tut, young gentleman ; we must have your opinion supposing such a case to have actually occurred.

Tatnall : Well, sir—sails all carried away, do you say, sir ?

Commodore : Aye, all—every rag.

Tatnall : Anchor gone, too, sir ?

Commodore : Aye ; not an uncommon case.

Tatnall : No rudder, either ?

Commodore : Aye, rudder unshipped. (Tatnall drops his head despondently in deep thought.) Come, sir, come ; bear a hand about it ! What would you do ?

* From "The New American Navy," and "The United States Naval Academy," by Park Benjamin.

Tatnall (at last and desperate): Well, I'd let the infernal tub go to the devil, where she ought to go.

Commodore (joyously): Right, sir; perfectly right! That will do, sir. The clerk will note that Mr. Tatnall has passed.

A naval advisory board was appointed which, in 1881, recommended that thirty-eight armoured cruisers should be built, of which eighteen should be of steel and twenty of wood, besides several other vessels. An influential minority of the board objected to steel lest it should be imported instead of being manufactured in the United States. But in 1882 a House of Representatives committee decided upon steel, not only as the best but as the only proper material for the construction of war vessels. The committee, cautious but determined, recommended the building of two 15-knot cruisers, four 14-knot cruisers, and one steel ram. The advisory board desired five rams, but one was tried as an experiment. This was the *Katahdin,* and she was a failure and the experiment was never repeated. Congress in 1883 decided on two cruisers, not six, of which one should be between 5,000 and 6,000 tons displacement and have the highest attainable speed, and the other of between 4,000 and 4,300 tons displacement; and both were to have full sail power and full steam power. But as no money was voted the ships did not appear. Another naval advisory board recommended the construction of a 4,000-ton vessel and three of about 2,500 tons, all of steel, and a smaller iron despatch boat. Congress in March, 1883, adopted the programme, eliminating only one of the smaller cruisers, and this time voted an appropriation.

The *Chicago* was the largest of these vessels; the other three were the *Boston, Atlanta* and *Dolphin.* They were built of American materials, and were the first vessels of the modern

U.S. RAM "KATAHDIN."

American navy. The *Chicago*, besides being a twin-screw vessel, had engines which recalled the type installed in the famous Stevens battery. The advocates of the old order adopted with alacrity the role of Job's comforters, and predicted with as much cheerfulness as the role would allow, the absolute failure of the new vessels. The *Chicago's* designed displacement was 4,500 tons, her engines gave her a sea-speed of fourteen knots, and she was armed with four 8-inch, eight 6-inch, and two 5-inch breech-loading rifled guns. The *Atlanta* and *Boston*, each of 3,000 tons displacement and speed of thirteen knots, carried two 8-inch and six 6-inch guns. The *Dolphin*, of 1,500 tons and fifteen knots, the despatch boat, was given one 6-inch gun. All four vessels had secondary batteries of smaller guns. The three cruisers at their trials attained sixteen knots or over.

Europe, which had treated the American fleets with derision, began to take a tolerant and amused interest in American naval construction when it became known that the new navy had been decided upon. The European powers only mustered eight 16-knot vessels among them, and when three American ships of that speed appeared, Euro e became profoundly interested. These ships and the *Yorktown*, built later, constituted the White Squadron which visited Europe about 1891, and showed the Old World what the New World could do.

The *Charleston*, the designs for which were purchased abroad, was provided with machinery and boilers supposed to embody the best features of the boilers and machinery of various foreign cruisers, but they had to be altered considerably before she was considered to meet American requirements. She was the first vessel of the new navy to be employed on a warlike service. The supposed filibustering steamer *Itata*, at the time of the Chilian insurrection in 1891, escaped from the custody of the

U.S. marshal at San Diego, and the *Charleston* was successful in the mission of overtaking her, which she did at Iquique, after steaming 6,000 miles. The *Charleston* was wrecked off Luzon in 1900.

In 1886 the United States made another extraordinary advance by authorising the construction of the second-class battleship *Texas,* the armoured cruiser *Maine,* the protected cruiser *Baltimore,* the dynamite cruiser *Vesuvius,* and the torpedo boat *Cushing.* The *Texas* and the *Maine* were the first modern armoured cruising ships constructed in the United States. They were decided upon as the result of the knocking to pieces in half an hour of China's wooden fleet by the French in the Min River, in August, 1884.

The *Cushing,* besides being the first American steel torpedo boat, was the first American warship driven by quadruple expansion engines. She was named to commemorate the officer who commanded the launch which rammed and broke a protecting boom, and blew up the *Albemarle* in the Civil War. The *Vesuvius* should be included rather in the category of freaks or comparative failures, for though her three pneumatic dynamite guns of 10½-inch calibre, designed by Lieut. Zalinski, could each hurl shells containing 200 lb. of dynamite or other high explosive at least a mile, they were soon outclassed by other artillery. These projectiles were thrown by compressed air, and not by explosions of dynamite. The *Vesuvius* was employed at the blockade of Santiago de Cuba in 1898, where she frightened the Spaniards with her dynamite shells, but did very little actual damage. Her three pneumatic guns projected abreast through the forward part of the deck, some distance aft of the bow, and sloped at an angle of about 45 degrees. The breech of each gun was in the hold, and the supports of the weapons were so connected

with the ship itself as to be practically built into it. The guns were therefore fixtures; their elevation was unalterable and when it was desired to discharge them to right or left or to alter the range the whole position of the ship had to be moved. The *Texas* and *Baltimore* were also built on designs purchased abroad. With the exception of three vessels acquired just before the war with Spain, all the American ships are entirely the products of American naval science. The first triple-screw warships were the *Columbia*—a very handsome ship, sometimes called the *Gem of the Ocean*—and her sister, the *Minneapolis*. Up to the attack upon the Spaniards in Cuba, the United States had retained a number of monitors, but the experiences of 1898 convinced the naval department that vessels of that class were out of date and unsuitable for modern warfare.

Although the American vessels were built in the United States the compound armour for the turrets had to be imported at first, and it was not for some years that American-made armour was available for the navy. Four battleships were launched in the early 'nineties, and with the *Texas* comprised the American battleship force in the war with Spain in 1898. The Americans showed their inventiveness in the matter of their warships, and not being content always to follow the lead of other nations, and being convinced that they could not make more or greater mistakes than some European naval architects had perpetrated, produced some remarkable vessels. They were the first to try the superposed turrets, or one turret placed on top of another. The *Kearsarge* and *Kentucky* were thus equipped, but the experiment did not give the results anticipated, and was not repeated. But the Americans had shown that the guns of one turret could fire over another turret, and some of the latest and most powerful ships of the super-

Dreadnought types have their turrets arranged so that this may be done.

The *Maine*, really an armoured cruiser, but described as a second-class battleship, was sent to Havana for political reasons in January, 1898, and was blown up at her moorings on the evening of the 15th of the following month, two hundred and sixty-six lives being lost. The explosion was attributed to the Spaniards, but this has been questioned, as an examination of the wreck, completed in the summer of 1911, was stated to have revealed that the cause of the disaster was the explosion of the vessel's magazines, but a later examination is said to have shown that the explosion was external. War between the two countries was now regarded as inevitable, and both made preparations for the struggle, Spain in that lazy and incompetent fashion which assured her defeat in advance, and the United States with as much thoroughness and care as the time allowed. The resources of the latter country were far superior to those of her opponent, but Spain by no means made the best of what she had. The American naval preparations were well conceived and as well carried out. The most notable exploit in this work was the remarkable voyage of the battleship *Oregon* from Bremerton, Washington, to San Francisco, and thence at her utmost speed round Cape Horn to Key West. It was the first time any steam warship had essayed such a feat, and that an American ship should have accomplished it was a feather in the American cap. Two or three foreign-built warships were acquired, but the European powers were friendly to Spain rather than to the United States in the war, and the latter acquired ninety-seven merchant steamers to act as auxiliaries to its fighting fleet, and distributed among them no fewer than five hundred and seventy-six guns

in order that they might take part in the fighting if circumstances required.

In the Pacific the American preparations were no less extensive than in the Atlantic. The first of the great naval battles of the war was that of Manila Bay. Admiral Dewey's flagship was the protected cruiser *Olympia*, 5,800 tons displacement, launched at San Francisco in 1892, and having four 8-inch and ten 5-inch quick-firers, fourteen 6-pounders and ten smaller guns. With her were the protected cruisers *Baltimore* 4,600 tons ; *Raleigh*, 3,217 tons ; *Boston*, 3,000 tons ; all heavily armed for their size, and a couple of gunboats.

The Spanish naval force consisted of the steel cruiser *Reina Cristina*, 3,520 tons, built at Ferrol in 1886, and carrying six 6·2-inch Hontoria guns, two 2·7 inch, and three 2·2 inch quick-firers, and ten smaller guns ; a wooden cruiser, the *Castilla*, 3,342 tons, built at Cadiz in 1881, and armed with four 5·9 inch Krupps, and sixteen quick-firers of various sizes ; two steel gunboats of English build and 1,045 tons, and some smaller Spanish-built gunboats and a number of torpedo boats. The shore fortifications had also been strengthened by the addition of a few heavy guns.

Though there was not a great deal of difference between the Spanish and American fleets at Manila, according to a comparative statement issued by the American navy department, the difference was on the side of the Americans, but with the land forces as well the advantage on paper lay with the Spaniards. The only instructions to Admiral Dewey were to " capture or destroy " the Spanish fleet. This, as it happened, was not a difficult task, for the Spanish vessels were in a deplorable condition of inefficiency, and the best that the Spanish admiral could do was to get his ships under the protection of the forts and keep them there. Not finding the Spanish ships

at Subig Bay, the Americans entered Manila Bay to look for them, heedless of the mines supposed to be strewn about the channel, but choosing a dark night illumined only by the flashes of lightning from the thunder clouds, as though the very elements were desirous of taking part in the coming struggle and were flashing their signals preparatory to the discharge of the sky's artillery. The American ships showed no light other than that at the stern of each vessel but the last, to enable that behind to follow in line. The defenders sighted them and opened fire, but the ships never paused, firing upon the batteries as they passed. The Spanish admiral, who, conscious of the condition of his ships, knew that his command was doomed before ever a shot had been fired, estimated his available tonnage at 10,111 as against the American 21,410 tons; his h.p. at 11,200, as against 49,290; his guns at seventy-six, as against the American one hundred and sixty-three; but he had a slight superiority in the number of men.

After day broke the Spaniards opened the battle, the batteries of Cavité and Manila starting the firing and being supported by the Spanish vessels. The *Concord* sent two shells at the Manila battery by way of reply, but the rest of the ships steadily steamed towards the Spanish ships, and it was not until the *Olympia* was within 5,600 yards of the ships that Dewey gave permission for the Americans to fire.

"You may fire when you're ready, Gridley," Admiral Dewey said in his imperturbable way. A second later, and one of the *Olympia's* forward guns had answered the Spanish challenge.

The American ships passed parallel to the Spaniards, and one after another concentrated its fire upon the *Reina Cristina,* the best ship the enemy possessed, and only fired upon the others when the cruiser was out of range. The Spanish admiral

essayed to attack the Americans by advancing against them with his one good fighting ship, thinking that possibly at closer quarters he might be able to meet his opponents with a better chance of inflicting damage. For bravery and audacity the feat ranks high in the annals of naval combats. But the chance he hoped for was never allowed him. A shell penetrated the *Reina Cristina* near the bows and, exploding, set her on fire. Almost at the same time a heavy projectile crashed into her stern and an 8-inch shell entered the hole thus made and exploded, setting her on fire at that end also, and damaging her engines. She retreated under as heavy a fire as a modern warship could withstand and yet keep afloat. Of her crew of four hundred and ninety-three men, but one hundred and sixty, of whom ninety were wounded, answered to the roll call after the battle.

Three times the Americans passed up and down before the Spanish ships, gradually decreasing the range to 2,600 yards. Ship after ship was disabled. Some took refuge behind the Cavité arsenal and were sunk by the Spaniards rather than be allowed to fall into the Americans' possession. One little iron gunboat, the *Don Antonio de Ulloa*, whose commander disregarded the Spanish admiral's orders to sink his ship, with sublime audacity prepared to offer battle to the whole American fleet. The *Baltimore*, *Olympia* and *Raleigh* opened fire upon her. The odds were too great. She fought bravely for a few minutes, but the guns of the assailing cruisers riddled her sides, and her crew left as she listed and sank with her colours flying. The American ships made short work of the shore batteries. The Americans in the battle of Manila Bay had seven men wounded, while the injury to the vessels was trivial. The Spaniards lost ten ships and had three hundred and eighty-one men killed and the wounded numbered hundreds more.

Determined to make no mistakes, the Americans took the Spanish fleet in the Atlantic at its strength on paper, ignoring the rumours of its neglect and inefficiency, and prepared to meet it accordingly. Spain possessed five armoured cruisers and a battleship, which were admitted by the Americans to be equal to America's six best ships, a few other vessels, and some torpedo boat destroyers. The real state of the Spanish ships is best revealed by Admiral Cervera himself. In one letter he wrote :—

"The *Colon* has not received her big guns ; the *Carlos V.* has not been delivered, and her 10-cm. artillery is not yet mounted ; the *Pelayo* is not ready for want of finishing her redoubt, and, I believe, her secondary battery ; the *Victoria* has no artillery, and of the *Numancia* we had better not speak."*

In another letter he complained of the absence of plans and of the supplies he had asked for not being forthcoming. "The *Colon* has not yet her big guns, and I asked for the bad ones if there were no others. The 14-cm. ammunition, with the exception of about three hundred shots, is bad. The defective guns of the *Vizcaya* and *Oquendo* have not been changed. The cartridge cases of the *Colon* cannot be recharged. We have not a single Bustamente torpedo. . . . The repairs of the servomotors of the *Infanta Maria Teresa* and the *Vizcaya* were only made after they had left Spain." And after his defeat at Santiago, when asked where were certain large guns which should have been on his ships, he answered that he supposed they were in the pockets of certain officials in Spain.

On May 19th, the Spanish fleet entered Santiago, after having crawled across the Atlantic to Curaçao, much to the relief of the Americans, who wondered where the fleet was

* "The New American Navy," by John D. Long.

and feared lest it should attack New York or some other wealthy Atlantic port. Once the fleet was inside, a strict blockade was maintained to see that it did not get out unnoticed. But the venture had to be made sooner or later.

"The fleet under my command offers the news, as a 4th of July present, of the destruction of the whole of Admiral Cervera's fleet. Not one escaped."

This was the message Admiral Sampson despatched on July 3rd to the Secretary of the Navy at Washington.

The situation had become a question of days when the Spanish fleet should find itself exposed to the fire of the American forces ashore. While his ships, in spite of their condition, were yet able to offer fight, Admiral Cervera decided on making a desperate sortie, or attempt to escape. It was the forlornest of forlorn hopes at best, for he had nowhere to flee to with any hope of reaching a place of safety, and turn which way he would, the American ships, well cared for, within easy reach of their base, with almost unlimited supplies, and eager for battle, were waiting for him. The Admiral, in the *Cristobal Colon*, led the way seaward through the narrow entrance to Santiago Bay, and fled down the coast. The other ships followed as best they could. The Americans sought to ram the Spaniards, but could not do so because of the latter's superior speed. The fleeing admiral's ship did succeed in getting away for the time being. The other ships as they appeared were fiercely assailed by the American ships. The Spaniards fought with that gallantry and reckless bravery which have been a prized Spanish tradition for centuries, but their shooting was so indifferent that few of the American ships were hit, some were not touched at all, and only one Spanish shell got home effectively on an American ship. The Americans, on their part, fired to hit, and hit they did. The armour of the Spanish

ships proved its value, and rang under the blows like anvils under the strokes of mighty hammers, and the ships shivered and heeled under the force of the impact.

The engagement began about half-past nine in the morning; by two o'clock in the afternoon the last ship, the *Cristobal Colon,* was run ashore sixty miles down the coast, and Admiral Cervera himself was a prisoner. In the interval the *Infanta Maria Teresa,* the *Oquendo,* and the *Vizcaya* were forced ashore and burnt, blown up, or surrendered, within twenty miles of Santiago. The *Furor* and *Pluton* were destroyed within four miles of the port. Cervera's ship was about two knots faster than the American ships which first assailed it, but it could not hope to escape the other American vessels lying off the coast, nor did it. In respect to fighting power, weight of metal, armour protection, and condition for fighting, the Spanish ships were hopelessly overmatched; and the Spanish guns, whatever may have been their value on paper, were as inferior as the Spanish gunnery. One knows not whether to wonder more at the state of mind of an administration which could send so ill-equipped and neglected a fleet to the seat of war, or at the extraordinary bravery of the crews who went in a patriotic cause to what was little else than certain death. The indifferent shooting which the Spaniards displayed in the Santiago affair, from first to last, prompted Captain (afterwards Admiral) Robley D. Evans, otherwise "Fighting Bob," to declare that they "couldn't hit a d——d thing but the ocean" when they missed his ship with unfailing regularity.

When the *Cristobal Colon* appeared, the *Indiana* headed close in shore to get within short range. The Spaniard fired her 11-inch Hontoria gun and missed. The American ship replied with her 13-inch guns, and then discharged every weapon she could bring to bear upon her ill-fated antagonist,

one shell exploding on the Spanish cruiser's deck. The *Iowa* and *Texas* took up the attack upon the *Cristobal Colon*; the *Indiana* joined with the *Brooklyn* and *Texas* in smashing the *Oquendo*, which stranded on fire. The *Vizcaya* next appeared to run the gauntlet, with two destroyers close behind her. The destroyers tried to torpedo the *Indiana*, but the American ship's secondary battery soon accounted for them, one drifting ashore and blowing up. The *Vizcaya* was set on fire by the American shells, but was fought until she was no longer tenable before she was surrendered. The *Eulate* was also surrendered. The *Cristobal Colon* raced with the *Brooklyn* and *Oregon* for 3,000 yards, until she struck the rocks bow-on and remained fast.

The destruction in such short spaces of time of the Spanish fleets in the Pacific and then in the Atlantic, with such little injury to the American side, demonstrated most unmistakably the importance and power of the new American navy. A few years later the famous cruise round the world was undertaken by an American fleet, and enabled the powers of the Old World to inspect some of the ships, and others of later date, which wrought such havoc. Yet such has been the progress of naval construction that not one of the ships which made the cruise is now included in the first rank of the American fighting line.

After the Japanese had decided to adopt war vessels of the Western types, they ordered a number of vessels of various kinds from builders in the United Kingdom. Their first ironclad frigate was the *Foo-So*, launched from the slip in Messrs. Samuda's yard at Poplar, from which the *Thunderbolt*, the first ironclad ever built for the British Navy, took the water. Another coincidence was that both the *Thunderbolt* and the *Foo-So* were launched with every armour-plate upon them.

The *Foo-So* had as her main deck battery, which was protected by armour 8 inches thick, four Krupp's long 23-cm. breech-loading guns, each weighing $15\frac{1}{4}$ tons. On the upper deck were placed two long 17-cm. Krupp guns of $5\frac{1}{2}$ tons each, but these were unprotected. The main deck battery projecting beyond the sides, permitted of a greater training to the guns. She carried a powerful ram, and her bowsprit, as was the custom with all vessels at that time fitted with a ram and bowsprit, was made so that it could be hauled inboard when a ramming attack was to be made. The ship was belted on the water-line with 9-inch armour and the vital parts were equally well protected. She was of 3,700 tons displacement, and fitted with trunk engines of 3,500 h.p. which, with a steam pressure of 60 lb., were calculated to give her a speed of fourteen knots; her coal capacity was expected to enable her to cover 4,500 miles at moderate speed. The first warship on Western lines which the Japanese built was a little barque-rigged vessel, the *Seika*, launched in 1875, a model of which is now (1911) in the Museum at the Royal Naval College at Greenwich.

The naval engagements in the Chino-Japanese war were not remarkable for much in the way of fighting, but chiefly for a pronounced objection by the Chinese officers as a whole to anything of the sort. A few of them, Admiral Ting among the number, did their best, but they were so hindered by their colleagues' incompetence and cowardice that they never had a chance of success. Guns that had been neglected, and shells from which the powder had been extracted and its place filled with charcoal, are not the best weapons for warfare, and when to these are added coal that was not much use and ships that were not in fighting condition, it will be seen that the victory of the well-organised Japanese was a foregone conclusion. One or two of the Chinese ships offered the best resistance they

could, but it was a hopeless resistance from the start. The Battle of the Yalu was won by the Japanese before a shot was fired. The few survivors of the Yalu fell victims at Wei-Hai-Wei. The training which a cavalry officer received in the Chinese army was not such as to fit him to command a fleet at sea, even of Chinese ships, but the former cavalryman who became commander of the Chinese fleet tried his utmost; his personal bravery was unquestioned, and he had preferred death to dishonour when he was found lifeless in the cabin of his beaten ship with a revolver by his side and a bullet through his brain.

Disciplinarian he was not. It is recorded that like most Chinamen he was an inveterate gambler, and that on one occasion when the fleet, as usual, was doing nothing, he found the time heavy on his hands, and when a visitor went on board the sentries were engaged in fan-tan in a secluded corner of the deck, the officers who should have been on duty were similarly engaged elsewhere, and the admiral himself was acting banker in that charming game with one or two other officers, and the sentry, who should have been on duty at the door of the admiral's cabin, joining whole-heartedly in the gamble.

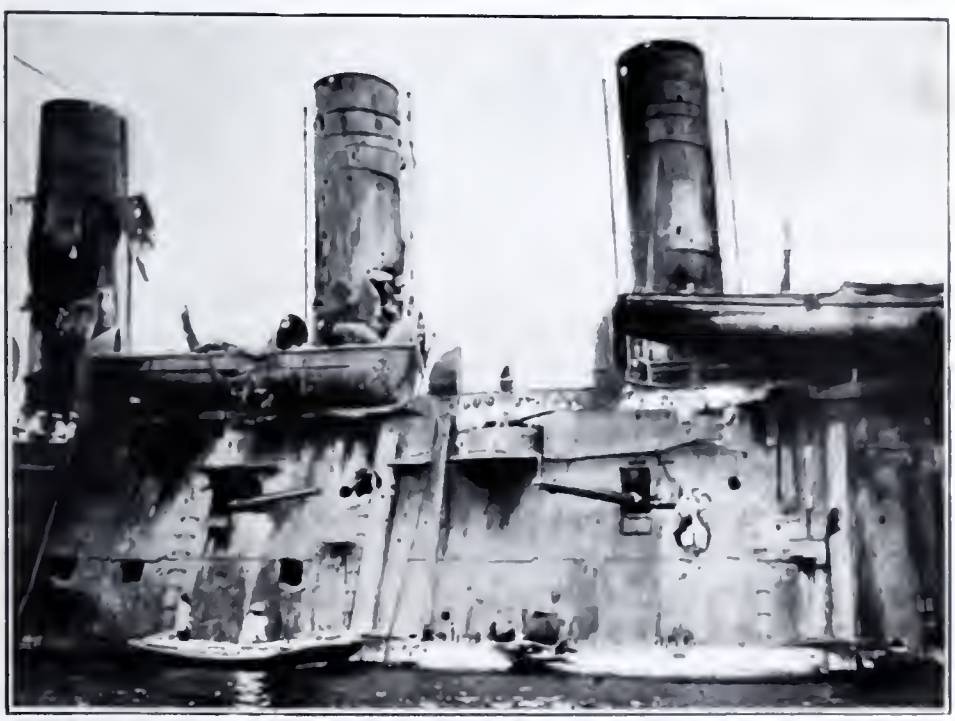
Of China's principal battleships, two fine vessels of 7,400 tons displacement, one the *Chen-Yuen*, surrendered at Wei-Hai-Wei, and having been repaired, was taken to Japan and added to the navy of her captors, and the other was sunk by a Whitehead torpedo during a night attack by torpedo boats at Wei-Hai-Wei. Similar fates befell a couple of armoured cruisers, and of the six smaller cruisers which completed China's fleet at the Battle of the Yalu, five were sunk or wrecked, and one surrendered. One was raised and added to the Japanese navy. Some of the ships of which China was despoiled distinguished them-

selves in the Japanese attack upon the Russians at the Battle of Tsushima.

The Battle of Tsushima, which ended Russia's naval pretensions in the war between that country and Japan a few years ago, is the only one in which modern ships and guns have been employed on both sides in anything approximating to equal terms. After the Russian squadron already in the Far East had suffered so severely at Port Arthur and the few vessels at Vladivostok deemed it advisable to stay there, Russia collected as many sea-going war vessels of all shapes and sizes as she could muster, and sent them out in two detachments from Europe in the hope that they would reach Vladivostok, Japan permitting. The voyage was exciting enough at the start when, through a bad attack of nerves, the Russians opened fire upon and damaged one or two British trawlers in the North Sea under the delusion that they were Japanese torpedo boats advancing to attack them. Loud was the outcry in Great Britain and great was the clamour that the British fleet should make short work of the Russian ships before they did any more damage. But the Government saved its powder and money and put its trust in the Japanese, confident that the Mikado's ships would do all that was necessary if the imaginative Russians ever got that far. The Russian ships were very slow, the best speed of which the fleet was capable was nine knots, and as the Russians themselves estimated the Japanese speed at sixteen knots, and this estimate was endorsed by the naval experts, it was taken for granted that the Russian fleet was going out to certain disaster.

The progress of this heterogeneous fleet was a matter of some months, but at last it approached the Japanese coast, off which the ships of the Mikado's fleet were waiting. The Japanese vessels, being of superior speed, were able to choose

THE RUSSIAN BATTLESHIP "TSAREVITCH" AFTER THE FIGHT OFF PORT ARTHUR, AUGUST 10, 1905.



EFFECTS OF JAPANESE SHELLS ON THE "GROMOBOI."

their own position for the attack. No innovations in the way of tactics were attempted. When the Japanese were ready they attacked, and they selected a moment for doing so when the slow-moving Russian ships were attempting to carry out an order of their admiral and were, in consequence of the order being incompletely executed, unable to offer a resistance to the suddenness of the attack. This very suddenness, indeed, threw them into greater disorder, and rendered them the more easily assailable by their relentless antagonists.

The Russian ships, too, were so overloaded with stores and coal that the upper edges of their heavy armour-plates were well below the water-line and, therefore, in so far as the hull protection was concerned, they were armoured cruisers and not battleships. The cabins, passages, etc., were so filled with coal that the sanitary arrangements for the men were blocked in some of the ships since leaving Leghorn, and the decks were in consequence in an indescribable condition.*

The Russian ships are said to have rolled very heavily owing to their having so much coal on board, and to the circumstance that their bunker coals were used before their extra supplies carried on their decks were consumed. However, the Russians fought their ships with the utmost bravery and determination, but the superior training of the Japanese sailors and their better gunnery told its tale, and in less than a couple of hours the Russian fleet was hopelessly defeated.

Admiral Togo, according to Lieut.-Commander W. S. Simms, must have gone into action with two principal objects clearly defined in his mind. One was to fight at the maximum range at which actual experience of battle practice had shown him that he could hit effectively, viz. about 6,000 yards, and at which he knew the Russian fire would not be dangerous; and

* Report by Lieut.-Commander Simms, U.S.N.

the other was to manœuvre so as to maintain as exactly as possible that range upon the head of the enemy's column. If he had not been able to accomplish these two objects, says the American authority, he might still have won the battle because of the Russian inferiority in many other respects, but the Japanese fleet would certainly have suffered more. If the Russians had been able by superior speed to run into 1,800 yards range, the battle range of their choice, they would have made a large percentage of hits, and those hits would have been very effective, especially from their modern ships of French design, the *Suvaroff*, *Alexander III.*, *Borodino*, and *Orel*.

The Japanese at first scored three hits to every one they received, and as the battle progressed and their men became more used to their work their hits averaged four to every one the Russians could manage to inflict on them. The accuracy of shooting at a greater distance than was formerly thought possible in an engagement showed the necessity of cultivating this branch of naval gunnery, and its value was demonstrated when the Japanese were able to concentrate the rapid fire of their best battleships upon the leading vessels of the Russian columns at such a range that the Russian fire was ineffective and wide of its intended mark.

Most of the Japanese big guns had lengths equal to thirty-five or forty times their calibres, and had already seen a great deal of hard work. This to a great extent may account for the Japanese not having hit oftener. The Japanese shooting in the later naval stages of the war, as compared with that in the naval attack on Port Arthur when the Russian squadron already in Far Eastern waters was crushed, is said to have shown a slight falling off.

The value of superior speed, of accurate long range firing,

and of protective armour is the principal lesson of the Battle of Tsushima. The one gives choice of position and all its attendant advantages; the second enables an enemy to be partially crippled so that he can be attacked by torpedo boats and sunk or rendered helpless, or can be overtaken and assailed by a fast cruiser if an attempt be made to escape. The battle also demonstrated the value of uniformity in speed of the principal ships, or ships of the line, for the Japanese admiral, knowing that his six battleships had each a speed of about twenty knots, knew exactly the positions he could expect each one to maintain. He had also a number of first and second-class armoured cruisers, and his scouts were reinforced by some of the best vessels in the Japanese mercantile marine.

The actual fighting resulted in the *Osliabya* being driven out of the fighting line in less than thirty minutes after the battle began, and in about an hour after the first shot, the gun-fire to which she had been subjected had set her on fire and caused her to founder. The *Kniaz Suvaroff* was obliged to leave the fighting line about forty minutes after the battle commenced, both these ships being rendered ineffective before the Russians had travelled five miles. Becoming isolated from her consorts, the *Suvaroff* was severely pounded. One of her masts and her two funnels were shot away, and a couple of torpedo boats attacked her and injured her below the water-line, so that she soon had a heavy list, but her watertight bulkheads kept her afloat for a time. Two Japanese destroyers then took charge of her and torpedoed her three times, inflicting such injuries that she soon went down. Shortly before this the *Borodino* received a shell in her magazine, which blew up and sent her to the bottom. The *Orel* surrendered after the battle, and presented an excellent object lesson of the service her armour had rendered her, for her partially protected and

unprotected parts were wrecked by the Japanese gun-fire, but not one of the shells had penetrated her heavy armour, though it bore ample evidence of the severity of the ordeal through which she had passed.

Enough has been written to show that the range at which naval engagements have been fought since steel took the place of iron for guns and armour has steadily increased. The old practice of getting close to an enemy and blazing away as fast as the guns could be loaded, in the hope of smothering his fire and a certainty of hitting something sometimes, has become as extinct as the dodo. Guns are too powerful for anything of the sort to be attempted now, and the object at present is to hit at the longest range at which the guns are considered really effective.

The *Dreadnought* is the logical outcome.

CHAPTER VIII

BATTLESHIPS AND CRUISERS

THERE was no sudden change from iron to steel in the building of warships. Steel at first was very expensive, and by no means the perfect article that we know at the present day, besides which the supply was very restricted, and the Admiralty by using it in conjunction with iron was able to ascertain the extent to which it might ultimately be adopted. Thus, in one ship, steel was tried for the keel, in another for the protective deck, in another for facing armour, in another for the frames, and so on. The two screw propeller shafts of the *Inflexible*, for instance, were made of Whitworth compressed steel. They were 283 feet in length and weighed 63 tons. Had they been of wrought iron they would have weighed 97 tons.

One of the earliest steel warships ever built, and certainly one of the smallest, was the Dutch gunboat *Handig Vlug*, launched on the Thames in 1864. Commenting on this little gunboat, the *Times* said: "The general term 'gunboat' conveys to our minds the image of a vessel built of 'sappy timbers' and rotten planking, carrying two heavy shell guns on their low unprotected upper deck, fitted with 60 h.p. (nominal) engines, and averaging no more than eight knots under the most favourable circumstances, a class of vessel that has figured for almost fabulous sums in our annual navy estimates for 'repairs,' etc., but, nevertheless, a class of craft that has left imperishable marks of its usefulness and power in many parts

of the world, and more especially on the rivers and seaboard of India and China."

A comparison between the gunboats of the British Navy, as revealed by the foregoing quotation, and the type introduced by the *Handig Vlug* is striking. She was stated to be the first vessel of any class, built on this side of the Atlantic, to carry her armour on the deflective principle instead of offering vertical resistance to the impact of shot. She was constructed entirely of steel, her plates below the water-line being only $\frac{1}{4}$ inch thick, but above the water-line they were $\frac{3}{8}$ inch thick, and the dome or cupola in which her battery was placed was composed of plates of similar thickness. This cupola occupied 60 feet in the centre of the vessel with a grated top for ventilation, and above this was a small pilot-house, resembling the usual American design, about 5 feet high. The cupola had three gunports at either end, permitting the guns to be trained ahead and astern, and on the bows or quarters. It also had a number of holes for rifle fire, which could be covered with brass slides when not in use. She was intended to be sufficiently fast under steam to be able to outstrip a battery operating on land in a country with so many watercourses as Holland, or to be rifle-proof if sent to Javanese waters. She was to carry two 12-pounder rifle shell guns and fifty riflemen. The length of this "hornet," as she was called, was 100 feet between perpendiculars, her beam was 17 feet, and her depth 6 feet 6 inches, and she drew only 3 feet of water; her tonnage was 138 tons. In rough weather this little low ship made a speed of ten knots on her trial trip, and being a twin-screw vessel—the engines and ship were built by the Dudgeons—she was put through some tests in the presence of Admiralty representatives, and made a complete circle in two minutes forty-seven seconds, and another in three minutes, while in going ahead at full speed

the course of the vessel was reversed by the altered action of the screws in one minute. The tests were held to "prove the worth of the double or twin-screw principle for purposes of warfare, as it has been proved before for some time for purposes of commerce, for handiness of any vessel under steam power is equally valuable for both purposes, whether in avoiding the shoals of a tortuous shallow river or in flanking the shore battery of an enemy."*

As steel is much stronger in proportion to its weight than iron, it followed that the adoption of steel for building warships meant a great saving in the weight of the hull. The weight thus gained could be utilised in three ways: by increasing the extent of the armour carried, by increasing the weight of the guns carried, or by a combination of the two. As steel was still further improved it became possible to increase the size of the vessels, the power and weight of the engines and boilers —in which the power increased to a far greater proportion than the weight—the speed of the ships, the strength and extent of the armour carried, and the effectiveness of the guns. It permitted also of a destructive secondary armament.

We have seen how from the old broadside ships of the *Northumberland* type came the central battery ships like the *Hercules*, the last of these being the *Superb*. Their armament also underwent a modernising process as time went on, and many of these old ships, from the *Warrior* onwards, were equipped with both quick-firing and anti-torpedo-boat guns, and were retained long after their fighting capacity had become a very doubtful quality, and their surrender to the tender mercies of the shipbreaker became imperative.

Meanwhile from the converted *Royal Sovereign* there descended a series of turret ships, some, like the *Cerberus*, *Devastation*

* *The Times*, December 24, 1864.

and *Dreadnought,* having two turrets on the centre line of the ship; others, like the *Rupert* and *Conqueror,* having one turret only; others, like the *Monarch,* having two turrets in the centre, and yet others having their turrets *en echelon* or placed diagonally, as in the *Inflexible.* The *Colossus* was an improved *Inflexible,* but of steel, and practically marked the end of the heavily armoured vessels of this type. From the double turrets and the central battery ships we have the combination of the two in the *Temeraire.*

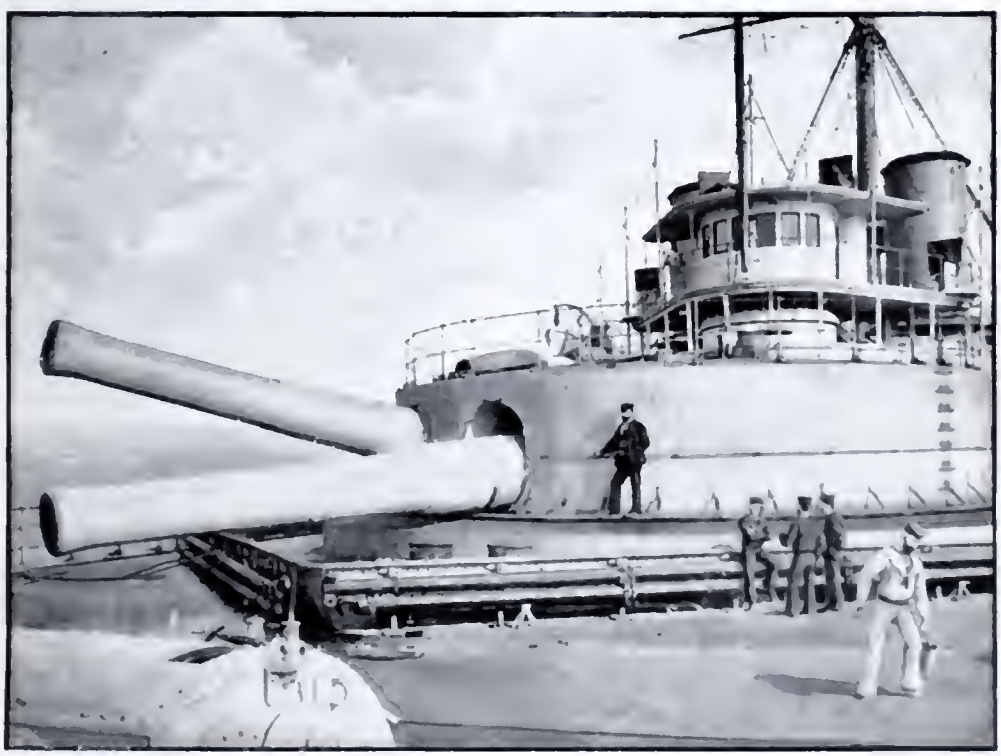
The *Colossus* and the *Edinburgh,* which were begun in 1882 and completed in 1886, may be said to have inaugurated a new era in the building of the world's battleships. They were the first battleships to be built wholly of steel for the British Navy, and were asserted to be more powerful as fighting ships than any other ships in existence. This was due not only to the material of which they were constructed, but also to the fact that they were given breech-loading guns, Great Britain being the last of the great Powers to dispense with the old-fashioned muzzle-loader. These ships were of much the same type as the *Ajax* and *Inflexible,* but their citadels were of greater length; they were of fourteen knots speed.

The *Nile,* launched in 1888, had a complete belt, and was the last low freeboard turret ship. She was preceded by what were known as the soft-ended barbette ships, because their ends were comparatively unprotected, the weight being concentrated amidships in order, among other objects, to increase the sea-going qualities of the vessels; the first of these was the *Collingwood,* begun in 1882 and launched in 1886, the principal armament being carried in barbettes.

The *Collingwood* has been regarded as the pioneer vessel of the modern battleship, for it certainly was the first in which the real advantages of steel were displayed. On her was intro-

H.M.S. "VICTORIA" FIRING 111-TON GUN.

Photograph by Sir W. G. Armstrong, Whitworth & Co., Ltd.



H.M.S. "VICTORIA," SHOWING 111-TON GUNS AND TURRET.

Photograph by Sir W. G. Armstrong, Whitworth & Co., Ltd.

duced the system of mounting four heavy guns in pairs on the middle line of the ship, not in turrets as in her predecessors carrying a few big guns, but in barbettes or fixed gun positions protected by heavy armour. The barbettes and turrets have been so modified in later ships that sometimes one term and sometimes the other is used by experts to denote the same design. The method of mounting the guns, as illustrated in the *Collingwood*, remained in vogue in the British Navy until it was supplemented by the *Dreadnoughts*. The *Collingwood's* side armour was 18 inches in thickness; the armour of her bulkheads was 16 inches, that of the conning tower 12 inches, and that of her barbettes, in which her four 12-inch 45-ton guns were mounted, was 11½ inches. She also carried six 6-inch guns and several smaller guns. Her displacement was very little more than that of the *Colossus*, but she was two knots faster. Other vessels, described as sisters to the *Collingwood*, followed, but they were all rather larger, among them being the *Camperdown*, which had the misfortune to sink the *Victoria* during naval manœuvres in 1893 in the Mediterranean, when Admiral Sir George Tryon and nearly all the crew of his flagship went down with the vessel.

The *Victoria* was a steel-armoured first-class single-turreted battleship, and was built at Newcastle-on-Tyne in 1887. Her armour was from 18 to 16 inches thick, and there was a protective deck 3 inches thick. She had two sets of three-stage expansion engines, and steam was generated in eight steel boilers with four furnaces each, which were fired from four independent stokeholds. She was one of the three ships to be armed with 111-ton guns, of which she had two in a turret forward. One 29-ton gun was mounted aft to fire over the stern, and she also had twelve 6-inch, twelve 6-pounder quick-firers, twelve 3-pounder quick-firers, eight machine guns, and

four torpedo tubes, two of which were submerged. Her displacement was 10,470 tons, length 340 feet, breadth 70 feet, and depth 27 feet 3 inches. The rapidity with which she heeled over and sank was supposed to be partly due to the weight of these enormous guns.

Great things were expected from the type represented by the *Benbow,* launched in 1885, and completed three years later, which, next to the *Inflexible* which cost nearly £800,000, was the most expensive ship Britain had then built, and cost the country close upon £775,000. She was very heavily armed, as she carried two 16.25 inch and ten 6-inch guns, all breech-loaders, and was the first vessel to be given five torpedo tubes. This vessel may be said to have inaugurated the big gun era, notwithstanding that she came under the category of soft-ended ships. The last British single-turret ship was the *Sans Pareil,* launched in 1887, and completed two years later, and in many respects a sister ship to the unfortunate *Victoria.* These three vessels did not give the satisfaction anticipated, and though various alterations were made in the *Victoria* no great improvement was effected, and the results were not considered such as to justify the construction of any more like them. The *Benbow's* big guns were in barbettes, and those of the *Sans Pareil* were in a turret.

The *Nile* and *Trafalgar,* which were begun in 1886, were of 11,940 tons displacement, and were the largest ships up to then built for the Navy. Their heaviest guns, instead of being in barbettes, were placed in turrets. These vessels were exceedingly heavily armoured, having a belt of steel no less than 20 inches thick, and above this was an armoured redoubt, or citadel, protected by compound armour 18 inches in thickness for 141 feet along each side, the redoubt having parabolic ends of the same thickness of armour, enclosing the turret bases.

Armour of equal thickness was placed on the turrets. The secondary armament, consisting of 4.7 inch quick-firing guns, was contained in an octagonal battery with steel sides 3 to 5 inches thick, placed between the turrets. These ships were 345 feet in length by 73 feet beam, and about 28 feet mean draught.

The *Royal Sovereign*, launched in 1891 and completed the following year, introduced what is known as the high freeboard barbette type, and in 1893 there was completed the *Hood*, the last of the British turret ships. The *Royal Sovereign* was noteworthy for several reasons. A record for rapid building was established in her, for she was laid down in September, 1889, and was launched as early as February, 1891, a quicker piece of work for a vessel of her dimensions and the weight of material handled than had ever been accomplished. One novelty about her armament was that she carried as many as eight Maxims. In her also the "big four" were 13½-inch breech-loaders, as against the 12-inch guns placed in her predecessors; these were mounted in pairs in barbettes. She also had ten 6-inch quick-firers, six of which were behind shields and four in casemates; and sixteen 6-pounders, twelve 3-pounders, and three torpedo tubes completed her weapons of offence. For the protection of the ship a belt of compound armour, 18 inches thick, extended along the water-line a sufficient distance to protect the bases of the barbettes. Across the ship at the top of the belt was a protective steel deck 3 inches thick, and this deck was continued at the level of the bottom of the belt to the extreme ends of the ship. Above the thick belt on the sides and protecting the ship as high as the main deck and from the fore to the after barbette was a belt of steel armour 4 inches thick, and above this, on the main deck, were the casemates enclosing the 6-inch quick-firers.

Altogether eight of these vessels were built, the *Hood* being the only one of them to be given turrets instead of barbettes.

Artillerists, however, were not to be beaten, and so far as steel armour and compound armour were concerned, the gun appeared once more to be obtaining the advantage. The Harvey process of strengthening the resisting powers of steel came to the rescue of the armour-plate. The *Renown*, which has been called a "half-way house" between the *Royal Sovereign* and the *Centurion*, was the first warship in the British Navy to be given Harveyised steel armour, of which both her armoured belt and her armoured bulkheads were constructed. Whereas in the *Royal Sovereign* the thickest armour was 18 inches, that of the *Renown* was 10 inches, and yet the latter was declared to be the better protected.

The extraordinary reduction in weight thus secured made possible the advent of the *Majestic* and *Magnificent*. These two vessels and the others of their class were as far in advance of the *Royal Sovereign* as the heavy ironclads were in front of the iron-plated ships. The side armour of the *Majestic* and *Magnificent* of Harveyised steel was carried to twice the height that was possible with the *Royal Sovereign*, and though it was only 9 inches thick it offered a resistance to penetration by hostile projectiles at least equal to that of the massive sides of the *Royal Sovereign*, and was far stronger than the ponderous iron masses piled upon the sides of the great turret ships of a few years earlier.

With the *Magnificent*, launched in 1894 and completed the following year, came the barbette ships with a high displacement. She, and the others of her class, carried four 12-inch guns and twelve 6-inch quick-firers, and thirty-eight anti-torpedo-boat guns, a number which had not been equalled by any other vessel except the *Royal Sovereign*, and five torpedo

H.M.S. "MAJESTIC."

Photograph by West & Sons, Southsea.

tubes, as against seven which had been installed in that vessel and her sisters. The *Magnificent* had a displacement of 14,900 tons and engines of 12,000 indicated h.p., a designed speed of seventeen and a half knots which she exceeded, a coal capacity of 2,200 tons, a belt of 9 inches of steel armour, and from 10 to 14 inches of steel for the protection of the main guns. The *Majestic* was another of the sisterhood, though there were certain differences of detail, no two vessels being precisely alike. She was 390 feet between perpendiculars and, including the overhang of the stern and the ram of 15 feet, about 430 feet in length. Her beam was 75 feet. Thus she was longer than the *Royal Sovereign* but of the same beam, which made her a faster ship, her speed on her trial having reached 17.8 knots, although her engines indicated about 1,000 less h.p. than the battleships of the programme of 1889.

All the ships of this class were remarkable for their appearance, which certainly justified such names as *Magnificent* and *Majestic*. The great height of the superstructure fore and aft gave the idea of a good deal of top hamper, which however was quite as great in the *Royal Sovereign*. The upper deck 6-inch quick-firers of that vessel were only protected by ordinary shields, but the new ships had closed-in casemates at each corner of the battery and double plating above. The bridges and deck-houses of the *Majestic* were set back to avoid the "blast" of the great guns, and the forward conning-tower stood clear of the bridge and had an uninterrupted view all round. In regard to the bridges she differed considerably from many of her predecessors carrying heavy armament, as the "blast" from the big guns would have rendered a position on the bridge far from safe, especially when they were fired abeam. In these vessels the four 12-inch 46-ton wire guns were placed two in each barbette; the breech and body of each gun was

protected by a steel hood with a maximum thickness of 10 inches. Their 6-inch guns were in casemates. The 12-inch guns were very powerful for their weight, and comparing them with some of their most notable predecessors, it was found that their energy nearly equalled that of the 67-ton gun and their perforating power exceeded that of the 110½-ton gun.

The *Majestic* and her sister ships were at the time they were added to the Navy the most powerful warships afloat. The smaller guns were unprotected, this being one of the objections urged against their design. They were provided rather for repelling attacks by torpedo boats, for which purpose they would no doubt have been very effective if they were not disabled by an enemy's gun-fire first.

The *Canopus* class, of slightly larger displacement but less draught and more lightly armoured, was a lighter version of the *Magnificent,* and but very little faster. The next year, 1898, saw the launching of the *Formidable,* which carried the same powerful armament as the last two, but was considered to have it better protected, as her belt consisted of 9 inches of steel and her main guns were protected by steel armour 12 inches thick. The displacement and horse-power of the engines were greater, but there was little improvement in the matter of speed. This was remedied in the *Duncan* and her class. She was 405 feet in length and 75 feet 6 inches beam, being 5 feet longer and 6 inches wider than the *Formidable,* and of about the same draught, but her engines were of 18,000 h.p. indicated, giving her an estimated speed of nineteen knots and an actual speed of over twenty knots on occasion. These two classes of vessels attracted more than usual public attention because of their cost, as although the cost of warships had been steadily increasing, the *Formidables* and the *Duncans* were the first in which the cost per ship exceeded a million sterling. A

H.M.S. "KING EDWARD VII."

Photograph by the Fairbourn Co., Limited.

H.M.S. "LORD NELSON."

Photograph by Stephen Crabb, Southsea.

somewhat smaller vessel followed in the *Triumph*, launched in 1903, which attained a speed of nearly twenty-one knots, and in which also the complete belt was revived. Her principal guns were four 10-inch and fourteen 7.5-inch quick-firers, and she had also twenty-four anti-torpedo-boat guns and two torpedo tubes.

The increasing power and range of naval guns rendered it necessary that better protection and more destructive weapons should be given to the ships, and accordingly there was introduced in 1903, and completed in 1905, the *King Edward VII.*, and eight of this class were built. Their displacement was 16,350 tons, and in this respect they were the largest ships yet built for the Navy, but though they were shorter than the *Triumph*, they were of 2 feet greater draught. Their armour belt was of 9 inches of steel, and their main guns were protected by 8 to 12 inches. These ships carried four 12-inch, four 9.2-inch, and ten 6-inch quick-firers, and thirty anti-torpedo-boat guns. They cost not far short of a million and a half sterling each. Their engines of 18,000 h.p. gave them a speed of about nineteen knots. In 1906, there was launched the *Lord Nelson*, carrying fewer guns but better protected. Her armament comprised four 12-inch and four 9.2-inch, besides twenty-nine smaller guns and five torpedo tubes, and the armour both of her belt and for her main guns was of steel 12 inches in thickness.

The *King Edward VII.* and *Lord Nelson* were the finest examples of the types of battleships carrying four big guns and a powerful secondary armament. Both classes were provided with four 12-inch guns, but the *Lord Nelson* and the *Agamemnon* marked an advance from the principle which had endured so long towards the principle of the all-big-gun one-calibre ship as exemplified in the *Dreadnought*. They were

not, however, ships carrying all big guns of one calibre, for instead of a secondary armament like that of the *King Edward*, they carried ten 9.2-inch guns and twenty-four smaller weapons. The *Lord Nelson* and *Agamemnon* were about 410 feet in length by 79 feet 6 inches beam, and on a draught of 27 feet had a displacement of 16,500 tons. They were 15 feet shorter than the *King Edward* class and 18 inches broader. Many naval men preferred the *Agamemnon* to the *Dreadnought*, when the latter appeared in 1906, on account of the greater rapidity of fire of the former; but against this it was contended that her hitting power at long range was less. Upon her trials the *Agamemnon's* engines developed 17,285 h.p. indicated, and gave her a speed of eighteen and three-quarter knots, both power and speed being in excess of the estimates. Her high freeboard was a notable feature; her forward guns were 27 feet and her after pair 22 feet above the water-line, while in a superstructure above them were the smaller guns some 34 feet above the water-line, where they were admirably placed for dealing with any attempt at a torpedo attack.

The *Agamemnon* was built by the Beardmore firm, at Dalmuir, and launched in June, 1906, and the *Lord Nelson* left the slips at Palmer's establishment at Jarrow in the following September. It was contended that their 12-inch guns were half as powerful again as any of similar calibre mounted previous to 1906. Of their 9.2-inch guns, eight were in what are called twin barbettes, and the other two in single barbettes between the others. There are also a few 12-pounders and a greater number of 3-pounders, thirty-five in all, most of which are in a somewhat exposed position. These ships have each a complete belt extending along the water-line from stem to stern, 12 inches thick amidships, and tapering to 6 inches at the bow and 4 inches aft, while the sides above the belt and between

the barbettes have 8-inch armour raised to the level of the upper deck; diagonal bulkheads, also of 8-inch armour, enclose the citadel at either end. Yet that 8-inch armour was declared by Mr. Beardmore, when the ship was launched, to be more than equal in its power of resisting projectiles to the 12-inch armour of only four years earlier.

In considering the development of the modern warship attention naturally turns to the battleship, but it should be remembered that other vessels of scarcely less importance help to constitute the modern navy, the most notable being the cruisers of various classes, the destroyers and torpedo boats, and submarines.

Broadly speaking, the cruiser of the present day is to the modern fleet what the frigate was to the line-of-battle ship in the days of the three-deckers. That is to say, she has to be the eyes of the fleet, able to show a good turn of speed, and capable of taking care of herself if need be. There the resemblance ends. The duties of the modern cruiser are multifarious. She has to be no less a commerce protector than a commerce destroyer, and while at one end of the scale she may be little more than a glorified gunboat, she may at the other end have to be able to take her place in the line of battle and help her more powerful sisters. Whatever her duties, speed is regarded as of great importance.

The *Iris*, in 1878, attained a speed of eighteen and a half knots, but more than seventeen years elapsed before this speed was equalled by any of the cruisers. Her sister ship, the *Mercury*, covered nearly 18.9 knots, or close upon twenty-two miles an hour. In 1895 the cruisers *Amphion* and *Arethusa* proved themselves able to exceed their designed speed of seventeen and a half knots, and thence onwards the increase in speed has been continuous, until we have the *Invincible* in the British

Navy capable of exceeding twenty-nine knots under service conditions and in only moderately fine weather, and the *Von der Tann,* in the German navy, possessing a speed of twenty-eight knots under the most favourable conditions of weather and lightness of stores. At one time the German ship was asserted to be the fastest large cruiser afloat, but her supremacy, if it ever existed, in this respect was very short-lived.

The *Phœton* was one of the last class of cruisers to be given square sails. Her canvas certainly proved useful to her, for her machinery broke down during her commissioning trials preparatory to the naval review at Spithead in 1897, and had it not been for her sails she would have been totally disabled. The incident was seized upon by those who still favoured the older methods which had done duty for so many hundreds of years, as an argument for the retention of sail power for the ships of the Royal Navy, and the modernists replied that such incidents were few and far between, and with the improvements in mechanism which science was continually making would become virtually impossible.

Naval experts do not always agree as to the differences between a battleship and a cruiser. There are vessels in either category which could not possibly be placed in the other; but on the other hand there are some vessels that may be classed as either one or the other, and the types of the fast battleship and the armoured cruiser have been approaching each other in late years in so many respects, that some cruisers are fit to take their place in the line of battle against all but the heaviest battleships, and the natural result has been the appearance of the latest type of warship suitable for either duty, and known as the cruiser-battleship.

The Japanese, in their encounter with the Russian fleet, utilised cruisers against the Russian ships of the line, but

THE GERMAN DREADNOUGHT CRUISER "VON DER TANN."

whether they would have been able to do so had the Russian battleships been in as good condition as were those of their Oriental opponents is a point upon which opinions differ. The cruisers, like the latest *Invincibles*, have been given the armament of a battleship, but they have been less heavily protected in order to allow them superior speed; everything, should they have to take part in a naval battle, will therefore depend upon their antagonists and the exigencies of the engagement as to the duties they will have to perform.

Every nation has its own classification of warships, and the varieties of modern warships are so numerous, and the estimates of their effectiveness so much at variance, that it is little wonder the descriptions assigned to the vessels do not agree. Thus the American *Maine*, sunk at Havana, was described with equal accuracy as a cruiser and as a second-class battleship. But the nations have, for the most part, adopted the British classification of cruisers, though they have not failed to modify it to suit their own views. First come the unprotected cruisers, then the protected cruisers of the first, second, or third class; then the armoured cruisers; and of recent years the battle-cruiser, or heavy cruiser, capable of taking her place in the line with battleships. The unprotected cruisers have no side armour or other protection worth mentioning, and are mostly used for police duties, such as guarding fisheries, etc. They are lightly built and armed, and of relatively good speed for their size, and the duties they have to perform usually constitute the chief matter for consideration in the design of the several vessels. The protected cruisers have strong steel decks to protect their engines, etc., besides a great number of watertight compartments, and are classified according to their size, armament and speed, and the work for which they are intended.

Although the Admiralty adopted iron ships, it did not finally abandon its old wooden ships until 1874—or a year after that in which the first steel vessel was built for the Navy—in which year the British Navy was enriched by the addition of the wooden corvettes *Sapphire* and *Diamond.* Iron screw-driven cruisers or corvettes were the successors of the smaller fast wooden vessels, and a number of fast unarmoured ships of various types were built. One of them, the *Bacchante,* had the honour of being selected for the cruise round the world of the present King, when he and his brother, the late Prince Albert Victor, joined the Navy as midshipmen.

The Americans claim that these types of vessels were introduced by the *Wampanoag,* which was designed at the time of the American Civil War to chase Confederate commerce destroyers. The extraordinary reports published in the sensation-loving American papers, and duly copied and accepted as true by the British papers, as to the speed and capabilities of this vessel and others of her class, in 1866, induced the British Government to decide on something similar, and, if possible, superior, and the *Inconstant* was the result. She was 333 feet in length by 50 feet beam, and had a displacement of 5,782 tons on a draught of 23 feet. She was built of iron sheathed with wood and coppered, this arrangement enabling a light hull to be constructed which should take the strain of the machinery without being subject to the same "working" as a wooden ship would have had to endure on account of the greater elasticity of the material. The wood sheathing protected the iron, and also enabled the bottom to be covered with copper, or "yellow metal" as the composition was called which was generally used for the purpose, in order to prevent barnacles, weeds, and other marine growths from accumulating upon the submerged portion of the hull and retarding the speed. Con-

sidering that barnacles and weeds will grow thus to a length of several inches, the extent to which the speed of a vessel will be hindered may be imagined. All unsheathed vessels, whether of wood or iron, were peculiarly liable to these growths, which are particularly luxuriant in tropical waters, and might have their speed reduced even as much as from ten knots to six knots. The difficulty was to enable an iron ship to carry a skin of copper or yellow metal, the latter being mostly used in the mercantile marine, and the former for ships of war, private owners with their own money to spend being usually more economical than governments with the taxpayers' money behind them, and not hampered by the problems of making the ships pay commercially. The *Inconstant* was launched in November, 1868, and was followed in 1873 by the *Shah*, whose famous encounter with the *Huascar* was alluded to in the previous chapter.

In 1879 the *Comus* class, usually called the "C" class, as their names began with that letter, and the *Leander* class were introduced, constructed partly of steel and partly of iron, their hulls being given a sheathing of wood. Their engines and boilers were given a protective steel deck over them 1½ inches thick, but otherwise they had little enough in the way of protection. The most famous of the former class was the *Calliope*, which, in March, 1889, made such a magnificently successful struggle against a hurricane, and fought her way from Samoa Harbour in the teeth of one of the most severe storms experienced in the Pacific. The consummate seamanship and cool daring displayed by Captain Kane in that struggle, lasting for hours, when six American and German gunboats in the harbour were wrecked, have made his feat memorable in the annals not only of the British Navy, but in the heroic records of the seamanship of all ages. It is no detraction from

the merits of Captain Kane's exploit to say that credit is due also to the members of his crew, whatever their station—and not least to the unknown hero who was at the wheel in that battle between man's science and Nature's force. All shared in the glory of the feat; from Captain Kane and his officers to the engineering staff who kept a set of unreliable engines going at a pressure they were never built to withstand, and to the half-naked coal-trimmers in the bunkers and firemen in the stokehold, who stuck to their work in the semi-darkness, knowing full well that in the case of failure on anyone else's part, or breakdown in the engines, they were doomed to die like rats in a trap.

The incident directed attention to the splendid sea-going capacities of these vessels, and for many years afterwards the "lines" of the smaller cruisers bore a strong resemblance to those of the *Calliope* and her sisters.

It was not, however, until 1883 that the first protected cruiser appeared. This was not built for the British Navy, but for a South American State, and under the name of the *Esmeralda* came from the slips at Elswick. She had a complete protective deck, and not simply a protecting deck over her vital parts, engines capable of giving her a high speed, and a powerful armament. She was the pioneer vessel of her class. The British naval authorities, however, preferred the armoured cruisers, and led the way in 1881 with the *Imperieuse* and *Warspite*, but soon abandoned this type and adopted the protected cruiser. These two vessels were each of 8,000 tons displacement, 315 feet in length, and had a partial belt of 10-inch armour along 140 feet on each side, transverse bulkheads 9 inches thick at each end of the belt, and a protective deck 1½ inches thick. They carried four 9.2-inch guns in separate barbettes, one forward, one aft, and one on either side, besides ten 6-inch guns, twenty-six smaller and machine

RUSSIAN CRUISER "RURIK."

By permission of Messrs. Laird, Ltd.

RUSSIAN CRUISER "ROSSIA."

Photograph by Stephen Cribb, Southsea.

guns, and six torpedo tubes. Their hulls, which were of steel, were sheathed with wood and coppered.

Other nations, notably France and Russia, adhered to the armoured type, the former producing the *Dupuy de Lôme*, and the latter the *Rossia* and *Rurik*. Both these vessels were built at St. Petersburg in 1896 and 1894 respectively, and must be distinguished from the present Russian cruisers bearing these names. The *Rossia* was terribly knocked about in the war with Japan, but has survived it, thanks to her armour. She appeared at the Diamond Jubilee Review in 1897 at Spithead. The *Rossia* and the present *Rurik*, the latter launched at Barrow in 1906, attracted attention on account of their speed, the former attaining twenty and a quarter knots and the more modern boat nearly twenty-one and a half knots. Both were heavily armed, the latter especially so, being the only Russian cruiser to carry four 10-inch guns. She has, besides, eight 8-inch guns, twenty 4.7-inch quick-firers, eighteen smaller quick-firers, and two torpedo tubes, and when she left the builders was one of the most formidable cruisers afloat. Accurate long-range shooting being indispensable, the *Rurik* is also fitted with a range-finding tower.

The new *Esmeralda*, built in 1895 for the Chilian Government by the Tyneside firm who built her earlier namesake, had not a little to do with the introduction of side armour on British cruisers, thanks to the improvement of the Harvey and Krupp processes of strengthening steel.

The *Powerful*, launched at Barrow in 1895, and the *Terrible*, launched at Glasgow the same year, were the largest protected cruisers afloat at that time, and will long be remembered by the public for the excellent service their crews rendered during the Boer War, and among naval architects and marine engineers and shipbuilders by reason of the bitter controversy that arose

over their installation of forty-eight Belleville water-tube boilers, they being the first cruisers in the British Navy in which these were carried.

As a contrast to these two was the armoured cruiser *Drake*, begun in 1899 and completed in 1902, and at that time the largest of her class anywhere. Though called a cruiser, she was a more formidable fighting-machine than the *Barfleur*, *Renown* or *Canopus*. With a displacement of 14,100 tons, and a length of 500 feet, and an equipment of Belleville boilers and engines developing 30,000 h.p., she and her sister ships could reach a speed of over twenty-four knots, and were faster than any other large vessels in the British Navy. She was belted on her sides with Krupp steel from one barbette to the other, and from 6 feet below the water-line to the level of the upper deck, and there was lighter armour above this. She had also two protective decks, the lower being 2 to 3 inches in thickness. Her two 9.2-inch breech-loading guns were in barbettes, and she was given sixteen 6-inch, fourteen 3-inch, and three smaller guns, which, like the last two classes, were quick-firers, and two machine guns.

The increase in gun power rendered necessary an addition to the protection of the vessels, and the *Devonshire* class of cruisers, which appeared early in the present century, were given 6 inches of armour instead of 4 inches. The ships of this class were tried for experimental purposes with four different types of water-tube boilers in combination with cylindrical boilers. These fast armoured cruisers were designed to replace the old protected cruisers, which were no longer equal to modern requirements, speed being now recognised as of very great importance.

It is not only in the larger ships, however, that examples of such extraordinary development are to be found. Progress

H.M.S. "INDOMITABLE."

Photograph by West & Son, Southsea.

H.M.S. "LIVERPOOL."

Photograph by J. Sankey, Barrow.

is shown by the smaller vessels in no less degree. The continually changing conditions of commerce have necessitated as many changes in the construction and armament of vessels whose duty it would be in time of war to protect commerce at sea, or maintain order in estuaries and rivers.

The *Dartford*, belonging to the "town" class of cruiser, may be regarded as one of the best existing specimens of the modern smaller cruiser. She is of 5,250 tons displacement, as compared with 4,800 tons in the *Liverpool*, one of the earliest of her class, the addition being largely required to carry an increase in her fighting power, as her armament includes eight 6-inch quick-firers, all well protected, and several smaller guns, as compared with two 6-inch guns and ten 4-inch guns in her preceding sisters. The machinery is of the same type and power as that installed in the earlier "town" cruisers, and in view of the high efficiency of the *Liverpool's* engines at her speed trials, the *Dartford* was expected to attain a speed of twenty-six knots. Besides her coal-bunkers at the sides, the *Dartford* has an armoured deck of nickel steel, with sloping sides extending well below the water-line. Her turbine machinery of 22,000 shaft h.p. is contained in three separate engine-rooms, and there are three separate boiler-rooms for her twelve water-tube boilers. Oil fuel is carried in her double bottom. She has two masts fitted with wireless telegraphy apparatus, and on the foremast is a platform from which the gun-fire can be electrically directed.

Some cruisers are distinctly lighter versions of battleships. As developments of the swift battleship of the *Magnificent* and *Duncan* types came the armoured cruisers *Cressy*, in 1899, *Drake*, in 1902, and the belted cruisers *Black Prince*, in 1904, and *Minotaur*, in 1906, whence there developed the cruiser-battleship *Inflexible* in 1907.

The *Dreadnought* cruisers as much surpass the preceding types of cruisers as the *Dreadnought* battleships surpassed the *Majestics,* etc. For that matter, *Dreadnought* cruisers, like the *Princess Royal,* as well as the *Queen Mary* now being built, "could steam round a fleet of pre-*Dreadnought* ships and fire when it suited them, keeping beyond the range which would enable the old battleship guns to penetrate the armour of the modern cruiser."*

The last of the *Dreadnought* cruisers launched to the time of writing, the *Princess Royal,* is the largest warship ever built by a private firm in England for the British Government, although she is stated to be exceeded by the battleship *Rio de Janeiro,* under construction at Newcastle for the Brazilian Government, which is asserted to have a displacement of 32,000 tons.

The *Princess Royal* is a cruiser copy of the battleship *Conqueror,* launched the same day. The principal differences between the two vessels are that the cruiser has a pair less of the 13.5-inch guns, and also has her side armour 2 inches less in thickness, in order that she may steam thirty knots or more in place of the battleship's twenty-one. Her beam is the same as that of the *Conqueror,* but in order to give her speed she is 700 feet over all as against the battleship's 545 feet. In fighting power the *Conqueror* is superior to the *Princess Royal,* the latter having only eight big guns. An idea of the enormous power required to drive these ships at the necessary speed, and especially of the increase in power as between the two vessels, is shown by the fact that turbine engines of 27,000 h.p. will give the battleship a speed of twenty-one knots, but the thirty knots of the cruiser require engines developing 70,000 h.p., or 27,000 more than the *Indefatigable,* which has done twenty-

* *Engineering,* April 28, 1911.

FRENCH CRUISER "ERNEST RENAN."

Photograph loaned by Société Anonyme de Chantiers et Ateliers de Saint Nazaire

FRENCH CRUISER "DANTON."

Photograph by Stephen Crib, Southsea.

nine knots. The vessel is to be completed for sea by March, 1912.

It will have been seen from the dimensions quoted of the various cruisers mentioned that they are longer in proportion to their beam than the battleships, the additional length being necessary to give them greater speed. There was launched at Elswick in 1895, for the Argentine Government, the protected cruiser *Buenos Ayres*, which was very narrow for her length. Though 424 feet over all, she was only 47 feet 2 inches in beam, by 22 feet in depth. Her displacement was 4,500 tons. Her normal speed was twenty-three knots, and under forced draught twenty-four knots. Like all the warships built on the Tyne for South American States, she was heavily armed. One of the most heavily armed ships of her size early in the present century was the Japanese cruiser *Tsushima*, launched in 1902, but she has been surpassed by the later vessels of the Japanese navy in speed, coal capacity and armament, the latest, which are not yet completed, though only classed as protected cruisers of 4,035 tons, having a coal capacity of 750 to 1,000 tons, and carrying two 6-inch guns, ten 4.7-inch, and two 3-inch guns, all quick-firers, and two machine guns.

A vessel which attracted considerable attention when she was begun in 1902—at various other times since when changes in her plans have been suggested to meet the views of French naval experts, or the theories of successive Ministers of Marine, a tinkering process from which she has not been the only sufferer on the other side of the Channel—until she was completed in 1908, is the *Ernest Renan* cruiser. The length of time which has elapsed between the laying-down and the completion of some French vessels has seen them surpassed by newer types from other shipyards, notably British, even before they have been commissioned. But this is not the case with the *Ernest*

Renan, which, apart from the *Dreadnought* cruisers, is an exceedingly powerful ship, and a great credit to her builders at St. Nazaire. She is rather narrow, being only 70 feet 6 inches beam, with a length of 515 feet, and her draught is 26 feet 9 inches. She is more effectively protected than many a battleship of a few years earlier, having an armoured deck 2 inches in thickness, an armoured belt varying from $6\frac{3}{4}$ inches to 4 inches, while above the water-line belt she carries armour varying from 5 inches to 3 inches in thickness. Her armament is remarkably varied, including, as it does, four 7.6-inch guns, twelve 6.4-inch guns, twenty-one 1.8-inch guns, and two 1.4-inch guns, besides two submerged torpedo tubes. Her main gun positions are protected by 8 inches of armour, and her secondary armament by 5 inches of armour.

CHAPTER IX

GUNS, PROJECTILES AND ARMOUR

The introduction of direct shell fire at Sebastopol was a most important advance in the science of attack, and was followed soon afterwards by the adoption of elongated instead of circular projectiles, the French leading the way. Both for solid shot and explosive projectiles, it became necessary to increase the range and accuracy. To do this the windage had to be reduced as much as possible and the barrels of the guns were rifled in order to give the projectile a certain amount of twist on its axis.

Rifled breech-loading guns were proposed by Major Cavalli, of the Sardinian artillery, and by Baron Warendorff, of Sweden, and experiments were made with the weapons in this and other countries. A great deal of difficulty was found in adopting rifling for heavy guns, owing to the much greater strain imposed upon the metal, and the difficulties were still further increased when it became necessary that ordnance should be produced of very large calibre and able to throw heavy projectiles with high velocities. One way in which it was sought to get over the difficulty was by reducing the charge of powder considerably, and as the form of the newer projectiles was different from that of the old spherical projectiles, and the windage was as far as possible eliminated, it was found that this plan gave the desired result. Wrought iron and steel replaced cast iron and bronze, though a few cast-iron rifled guns were strengthened with steel hoops. Wrought iron was adopted for gun carriages, and steel or chilled iron for armour-piercing projectiles.

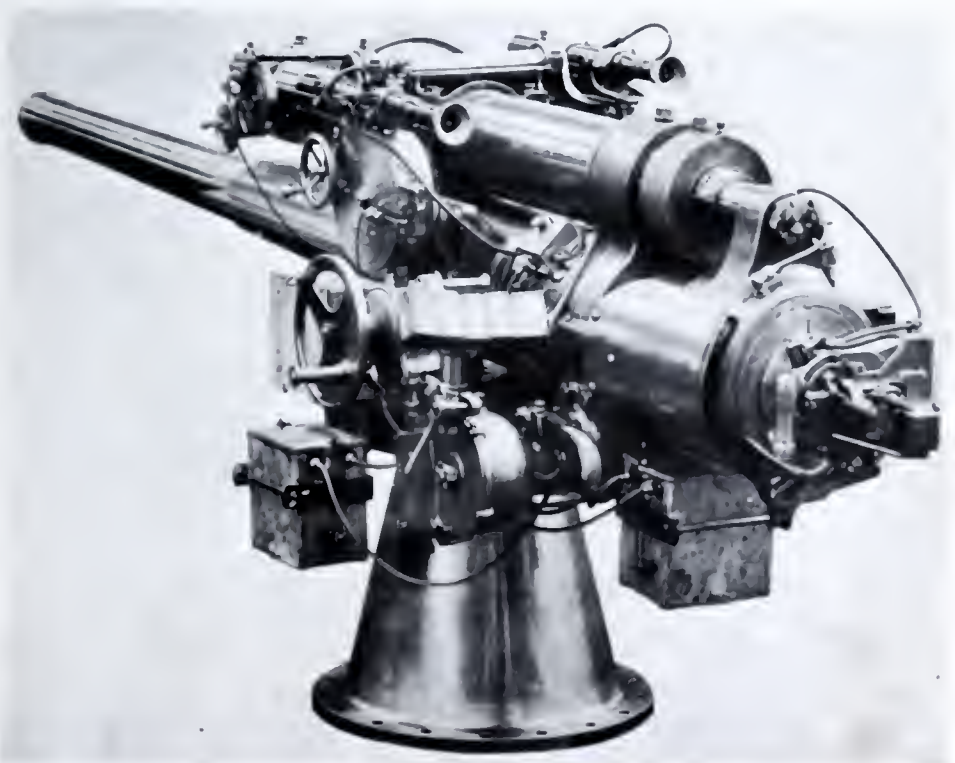
Sir Henry Bessemer manufactured the first gun that was ever made of malleable iron without a weld or joint, and though he showed that guns could be made of steel, the Admiralty, with its then fondness for the things of the days that were, decided to continue making its guns of iron. But when the bore of the iron gun showed cracks, the Admiralty decided on the insertion of a steel tube, and tied it with a piece of iron.

"Why not with a piece of steel?" Sir Henry Bessemer asked, in 1881, many years later. "Why not a cylinder made of steel in preference to that iron coil? For the making of steel cylinders was then an accomplished fact, but the making of those iron coils was not an accomplished fact. The iron coil system has been thoroughly shown up, but at an enormous expense to this country. The incident was the turning-point which made us have iron guns, while every other country in the world has got steel guns." But the next year the Government decided that the Navy's guns should be constructed entirely of steel.

At the International Exhibition of 1862, a spherical steel cannon-ball was exhibited, and in January, 1864, some particulars were published of trials of projectiles of this class fired from a smooth-bore against armour-plate $5\frac{1}{2}$ inches in thickness. This moved Sir Henry to remark that an expenditure of £50 three years earlier would have given as full a proof of the efficiency of these projectiles.

"Meanwhile how many hundred thousands pounds have been expended in building iron-plated ships, which these long-neglected steel projectiles will riddle as easily as the cast-iron shot found its way through the wooden walls of our old men-of-war! . . . It is not less remarkable that while our firm at Sheffield have manufactured some hundred and fifty pieces of Bessemer steel ordnance for foreign service, guns of this material are still untried by our government, although it is well known that the strength of this metal is

12½-PR. Q.F. 50-CALIBRE GUN AND MOUNTING.



4-INCH B.L. 40-CALIBRE GUN AND MOUNTING FOR TORPEDO BOAT DESTROYERS.

Photographs supplied by the Coventry Ordnance Works, Ltd.

double that of ordinary iron, while such is the facility of production that a solid steel gun block of twenty tons in weight can be produced from cast fluid in the short space of twenty minutes, the homogeneous mass being free from weld or joint.

"Our armour-plate system has certainly received a severe shock, and it behoves us now to see how far it is possible to increase the resisting power of ships so as to keep pace with the advances made by steel shot. . . . The fine ship *Minotaur* . . . was all that excellent workmanship and the best iron could make her, but still she was only iron. It has been stated that the hull of the vessel weighs 6,000 tons, and her 4½-inch armour 1,850 tons. Now, had the hull of this vessel been built of a material possessing double the strength of ordinary iron her weight might have been reduced to 3,000 tons; but suppose that, while we admit a double strength of material, we only reduce the weight by one-third, this would give 4,000 tons of steel for the hull. Now, with this reduction in the weight of the hull, we may employ 9-inch armour-plates in lieu of the 4½-inch armour-plates now employed. It must be borne in mind that the resistance offered by the armour-plate is equal to the square of its thickness; hence a vessel constructed in the manner proposed would bear a blow of four times the force that the present structure is calculated to withstand. Thousands of Bessemer steel projectiles are now being made for Russia. . . . Have we a single ship afloat that can keep out these simple round steel shots fired from a common smooth-bore gun, if ever directed against us?"

After a remarkable series of experiments, Sir Joseph Whitworth produced a number of rifled guns of great power and precision. In 1863 they proved their worth in the Civil War in America, and in 1864 a series of competitive experiments was conducted by the British Government at Shoeburyness between the Armstrong and Whitworth guns. The committee of artillerists reported its inability to decide which was the better weapon, and the Whitworth gun was not then adopted by the Government, though foreign nations bought them largely. Four years later a Whitworth gun was produced which threw

a 250-lb. projectile 11,243 yards, a range never before attained, and a 310-lb. projectile, 11,127 yards. Sir J. Whitworth also attempted to prove that a flat-headed projectile will penetrate armour-plates even when striking obliquely.

Like all inventors of war material of increased efficiency, he believed that the more destructive the weapons and explosives the more improbable would war become, until it should be rendered impossible.

"Were it not that the increased destructiveness of war must tend to shorten its duration and diminish its frequency —thus saving human life—the invention of my projectiles could hardly be justified; but believing in the really pacific influence of the most powerful means of defence, these long projectiles I call the anti-war shell." But Sir Joseph Whitworth was disappointed, and the millennium has not dawned yet.

His own summary of what he accomplished, however, shows how one step after another has been taken in the production of weapon after weapon. The progress has been maintained by one inventor and scientist after another, until the remarkable guns with their 25-miles range which now are carried have been made possible.

"In 1857 I proved for the first time that a ship could be penetrated below the water-line by a flat-headed rifled projectile.

"In 1860 I penetrated for the first time a 4½-inch armour-plate with an 80-lb. flat-headed solid steel projectile. In 1862 I penetrated for the first time a 4-inch armour-plate with a 70-lb. flat-headed steel shell, which exploded in an oak box supporting the plate. In 1870 I penetrated with a 9-inch bore gun three 5-inch armour-plates interlaminated with two 5-inch layers of concrete. In 1872, with my 9-pounder breech-loading gun and a flat-headed steel projectile, I penetrated a 3-inch armour-plate at an angle of 45 degrees. All these performances were the first of their kind and were made, with

one exception, with flat-headed projectiles, which alone are capable of penetrating armour-plates when impinging obliquely, and which alone can penetrate a ship below the water-line."

The Brazilian Government began a series of experiments in 1871 which convinced them that better guns were produced in this country than on the Continent. The Bessemer steel process was improved by Sir Joseph Whitworth for gun-making, and having adopted breech-loading guns, he obtained results superior to those obtainable with any form of muzzle-loading weapon. The Brazilian Government gave permission for him to offer to lend to the British Admiralty a 7-inch breech-loading steel gun he had made for the former, and a 35-ton muzzle-loading gun, in order that comparative tests might be made, but the British Government declined ; it had no love for breech-loaders.

Having produced a type of gun capable, as he believed, of penetrating any armour then in existence, Sir Joseph Whitworth set about producing an armour-plate which should be able to beat the gun. Using his compressed steel, he invented what he called "impregnable armour-plating," built in hexagonal sections, each of which was constructed of a series of concentric rings arranged round a central circular disc, this method preventing a crack caused by the impact of a projectile from passing beyond the ring in which it occurred. A Palliser shell of 259 lb. fired from a 9-inch gun with a charge of 50 lb. of pebble powder, which would have smashed an ordinary 12-inch iron armour-plate, was itself smashed against this new armour, and the target itself was forced 18 inches back into the sand and was only slightly dented.

A great deal of reliance was placed in America on the gun invented by Mr. Rodman, after whom it was named. Several of the American monitors were armed with these weapons.

One, bought by the British Government and tested at Shoeburyness, weighed 19 tons and had a smooth bore 15 inches in diameter, and fired a round shot of 453 lb. with a charge of 100 lb. of American powder. It pierced the 8-inch plates of the *Warrior* type of target, but as in other experiments it was less successful, the Americans claimed that it was used in such a way as not to show its full capabilities. Even if it had been, it could only have had a very short career, as the breech-loading gun was steadily making its way in foreign navies, and any form of smooth-bore muzzle-loader, whether American or English, would have proved singularly ineffective against ships carrying rifled breech-loaders. The Mackay gun, an English invention doomed to early supersession, was an attempt to combine the simplicity of the smooth-bore with the penetrating force of the rifled gun, and in experiments made with this weapon on the *Agincourt* target, in 1867, the gun fully demonstrated its usefulness.

No satisfactory results either with rifling or with the hexagonal bore could be obtained, and as guns became more powerful it was found that the only way of utilising them with the best results was by loading them at the breech instead of at the muzzle. Obviously, a heavy explosive shell could not be rammed down a big muzzle-loader. The old 32-pounder had a muzzle velocity of 1,600 feet per second, and the 40-pounder rifled breech-loader which took its place was of only 1,200 foot seconds, and the muzzle energy was 570 and 400 foot tons respectively. Various methods were employed and were not by any means satisfactory, but when slower burning powders were introduced, the strain upon the gun was less sudden and more cumulative, so that the pressure upon the projectile was exerted to the full as long as it was within the gun and it was then expelled at the muzzle with the greatest force obtain-

HEAVY GUN UNMOUNTED.

6-INCH B.L. 50-CALIBRE GUN COMPLETED AND WITH MOUNTING

able. A great advance in naval gunnery was made with the appearance of the Armstrong breech-loader. The first breech-loader from this famous firm was a tube gun which was formed to admit of a breech block being dropped in to close the bore and a screw attachment held it fast. From about 1860 the principal guns in use in the Navy of the Armstrong screw type were the 9-pounder weighing 6 cwt., the 12-pounder weighing 8 cwt., the 20-pounder of 16 cwt., the 40-pounder of 35 cwt., and the 7-inch gun, 99½ cwt. The last-named was of 7.2 inches diameter, and fired projectiles weighing 109 lb. All these guns were on the polygroove system. About this time iron or steel gun carriages were introduced for use on shipboard. The Admiralty, for some reason best known to themselves, fancied muzzle-loaders, and obstinately remained faithful to them long after all other naval powers had discarded them as cumbersome and comparatively useless compared with the newer types of breech-loading guns. The newer muzzle-loaders, however, were improvements on the old smooth-bores, and were built on what is known as the Fraser system, and they were far larger than any which had been constructed before.

The inner barrels of the Armstrong 12-inch, 9-inch, and 7-inch muzzle-loading guns were of tempered steel, with solid ends; these were strengthened with wrought-iron coils shrunk on; the trunnion ring, breech-piece and cascable, which was screwed into the latter, were solid wrought-iron forgings. The different parts were hooked together with shoulders and corresponding recesses, to prevent their separation.

The muzzle-loader of 64 lb. on Fraser's cheap construction plan consisted simply of a coiled iron tube, having the muzzle part double, but with a triple coil over the breech.

The Armstrong big muzzle-loading guns were formed with the Woolwich system of rifling or grooving, the projectiles

being fitted with studs to correspond to the grooves. The muzzle-loading guns varied from the 7-inch 7-ton gun to the 16-inch 80-ton gun. The 8-inch was 118 inches in length, the 9-inch 125 inches, and so on, up to the 16-inch gun, which was 288 inches in length ; the last-named took a charge of 450 lb., and fired a projectile weighing 1,684 lb. with a muzzle velocity of 1,590 foot seconds and a muzzle energy of 29,530 foot tons, capable of penetrating at the muzzle between 24 and 25 inches of wrought iron.

By 1877 the initial velocity of rifled projectiles had been increased from 1,600 to 2,100 foot seconds, and the energies by nearly 75 per cent., so that a further reconstruction of artillery became compulsory. It was not until after 1881 that the Admiralty definitely adopted heavy breech-loading guns for its armed cruisers. Even as late as 1885 the squadron sent to sea when it was feared that trouble with Russia was brewing, included thirteen battleships, not one of which had a breech-loading gun of more than 6 inches diameter. As a contrast to this, all the heavy guns of the Russian ships were breech-loaders. What would have happened to the English ships had hostilities occurred, and had the Russian gunners been able to use their weapons properly, is best left to conjecture, but it might have proved a sorry day in the naval history of England. Even by 1894 muzzle-loaders were still in use in the Navy.

The Woolwich Armstrong breech-loading guns varied from 12-pounders of 3 inches to the 16.25-inch 111-ton gun, the length of which was equal to 30 calibres. The last-named gun took a charge of 960 lb. of powder, and fired a projectile weighing 1,800 lb. with a muzzle velocity of 2,087 foot seconds, and a muzzle energy of 54,390 foot tons, calculated to penetrate over 36 inches of wrought iron at the muzzle. Gunpowder not being powerful enough for these great weapons, other explosives

were introduced, which had, among other advantages, that of being much more powerful. The principal of these explosives at present in use is cordite.

In the early 'sixties the guns chiefly in use on this side of the Atlantic were the 9-inch gun, weighing 12 tons, and discharging a 250-lb. shot with 43 lb. of powder, the initial velocity being 1,730 feet per second. The largest gun was the 23½ tons, with a 12-inch diameter, its shot weighing 600 lb. and the charge of powder 70 lb., and the muzzle velocity being 1,240 feet per second. The larger guns could not be worked without considerable improvements being made in the ships themselves. Greater height had to be given between the decks, and the distances between the guns had also to be increased, there being 25 feet between the centre lines of the ports for the 12-ton guns, while the 23-ton guns required about 30 feet between the ports and between 8 and 9 feet between the deck and the underside of the beams supporting the deck above. To keep the portholes as small as possible an arrangement was made whereby the gun should be pivoted near the muzzle.

The later developments in naval artillery began with the 12-inch 46-ton wire gun, which was the chief weapon of the battleships between 1894 and 1897. This gun was 37 feet 1 inch in length, or 35.43 calibres, and threw an armour-piercing shell of 850 lb. with a charge of 167½ lb. of cordite. It had a muzzle penetration of 36.8 inches of wrought iron, and was in every respect as powerful as the 13½-inch 67-ton gun, which it replaced. During 1898, the 12-inch wire gun, weighing about 50 tons, was introduced.

The adoption of breech-loading made possible a very rapid rate of firing, even with the heaviest guns. In 1881, the Government, in reply to an invitation it issued for guns to meet certain requirements, received a number of replies from gun-making

firms, as did also the French Government at about the same time in reply to a similar invitation. These guns, which became known as quick-firing or rapid-firing guns, were comparatively small weapons, and the Armstrong Company at Elswick, having improved upon them with quick-firers of 4.7 inches and 6 inches calibre, they were adopted throughout the Navy as the secondary armament. Their superiority over those they displaced was such that a battery's firing power was increased sixfold. An important trial took place on board the *Hardy* in 1887, when a 4.7 gun was mounted on a centre pivot recoil mounting, the whole weighing 4 tons 12 cwt.; this gun fired ten rounds in less than 48 seconds. Compare this with the firing of the ordinary 5-inch breech-loading gun on the gun-boat *Mastiff*, when ten rounds took 6 minutes 16 seconds.

In rifling some of the guns an increasing twist was given, while in others the twist was uniform throughout the bore. The object of the increasing twist was to lessen the strain upon the gun, as the rotary motion was not started when the projectile was first put into motion, but developed as it moved down the bore. The projectiles were provided with studs which fitted into the grooves. The breech-loading guns on the polygonal system of rifling fired projectiles which were coated with lead fixed on with zinc, so that the bore of the gun was not injured by the rush of gas past the projectile as was the case in the rifled guns in which there was windage. Two systems of breech-loading were designed by Sir W. Armstrong, one being the screw system and the other known as the wedge.

The projectiles invented by Major Palliser were specially designed to penetrate iron armour. Cast iron was found to be smashed against armour, wrought iron was too soft to do any damage, and steel in those days was too expensive to be of use. Major Palliser solved the difficulty by making his

PROJECTILES AND CHARGES USED IN THE BRITISH NAVY.

Photograph by Stephen Cribb, Sydney.

1. Projectile, 16·25 B.L., 1,800 lbs.
2. Charge for ,, ,, 460 lbs. powder.
3. Projectile, 13·5 B.L., 1,250 lbs.
4. Charge for ,, ,, 185½ lbs. cordite.
5. Projectile, 12-in. B.L., 850 lbs.
6. Charge for ,, ,, 211 lbs. cordite.
7. Projectile, 9·2 B.L., 380 lbs.
8. Charge for ,, ,, 110 lbs. cordite.
9. Projectile, 7·5 B.L., 200 lbs.
10. Charge for ,, ,, 77½ lbs. cordite.
11. Projectile, 6-in. B.L., 100 lbs.
12. Charge for ,, ,, 25 lbs.
13. Projectile, 5-in. B.L., 50 lbs.
14. Charge for ,, ,,
15. Projectile, 4·7, 45 lbs.
16. 4·7 Cylinder for Cartridge.
17. Projectile, 4-in., 25 lbs.
18. 4-in. Cylinder.
19. Projectile, 12-pounder.
20. 12-pounder Charge.
21. 12-pounder Case Shot.
22. 12- ,, 8 cwt. Charge.
23. 6- ,, Cartridge.
24. 3 ,, ,,
25. 1¼ lb. Cartridge.

projectiles of chilled iron, and giving them a cylindrical shape with the pointed or ogival head.

Experiments are often carried out to ascertain the resisting qualities of various combinations of armour offered to projectiles of varying weights and penetrative powers according to the distances at which they are fired. When iron was used for armour-plating, targets were built in duplication of those provided for the armoured ships. Both the Armstrong and Whitworth 70-pounders fired in the competition trials over 3,000 rounds, or three times the number assigned as the limit to the life of the old cast-iron smooth-bore guns. Of course, the bigger the gun the shorter the life, as a rule.

The French adopted for naval service four different patterns of heavy breech-loading rifled guns, all made of cast iron, and strengthened behind the trunnions with steel rings which were shrunk on. Their weight varied from 21 tons 13 cwt., with a calibre of 10.82 inches, to the gun of 4 tons 18.5 cwt., with a calibre of 6.48 inches, firing projectiles respectively of 476 lb. and 99 lb. The weight of the charge was rather more than one-sixth of that of the projectile. The guns were mounted on wrought-iron carriages and slides constructed on the box girder system.

As the powers possessed a great number of old smooth-bore guns and rifled guns were expensive, several attempts at a compromise were made by lining the smooth-bore guns and converting them into rifled guns, the lining being rifled according to whichever system the power owning the gun happened to prefer at the moment. The Dutch Government is said to have set the example of national frugality in this respect.

How slow the Admiralty was, is shown by the statement of the Secretary to the Admiralty in the House of Commons

in March, 1881, to the effect that "at this moment there is not a single heavy breech-loading gun mounted on any of our ships, but by the end of next year a very substantial beginning would have been made towards arming our fleet with breech-loaders. . . . The Admiralty was driven to the step by the fact that a high velocity was now required for the projectile, that high velocity was only obtainable by a great length of gun, and that to load a gun over a certain length at the muzzle became impracticable under the ordinary conditions of mounting guns afloat." The Government, it was contended, was now able to profit by the experience which foreign nations had gained, and intended to improve upon the guns which were in use abroad. But whatever may have been the official view, the fact remains that the Admiralty was years behind other nations, that Woolwich, in spite of official claims, discovered nothing that had not been known to be possible a decade earlier at least, and that the Navy was armed with out-of-date muzzle-loaders. Fortunate it no doubt was for this country that it had no wars in which its Navy could be tested against a navy armed with breech-loaders.

In the matter of armour this country owes a debt of gratitude to Sir John Brown, who made the Atlas Works at Sheffield famous throughout the world for the excellence of the armour-plates produced there. Indeed, the records of what he has accomplished seem to indicate that his rule was to surpass whatever his rivals produced, and never to forget that he might be able to learn something from others. His company took up the manufacture of chrome steel, which was patented in America about 1871. When the Italian experiments at Spezzia resulted in the 100-ton gun smashing, in 1876, 22 inches of iron armour and its backing, the French turned their attention to steel plates, as did also Sir Joseph Whitworth, but Sir

John Brown thought that better results would be secured with iron plates with steel faces. These compound plates had half their thickness of steel. By 1883 the firm was producing compound plates each 32 tons in weight.

An interesting comparison between French and English methods was made a few years ago* by M. Canet, of the well-known French firm of gun manufacturers, in a paper on the heavy naval guns and warships of the two countries. Referring to the latest type of the large weapons then employed at sea, viz., the English 12-inch gun, known officially as Mark IX., he described its method of construction, which has already been alluded to, and pointed out that the corresponding gun in the French navy was of 305-mm. bore (or 12.008-inch) and of 45 calibres in length. The barbette system of gun-mounting, as already explained, owed its origin to French inventiveness, and is preferred in the British Navy: but the French, curiously enough, seem to have preferred the English system of mounting turrets for the guns. The turrets themselves, however, differed from those of the English pattern, the French idea being to make them oval and smaller, so as to offer the narrowest possible target, and this theory was carried into practice even at the expense of the interior roominess. The limited dimensions, however, made it no easy task for artillerists to arrange conveniently inside the turrets all the machinery required, and M. Canet avowed a preference for the English practice of allowing the designer plenty of weight and room inside the turrets or barbettes. There were also structural differences in the methods of the two countries of arranging the armour, and it was claimed that the French oval form, with the other characteristics, had, among other advantages, that of distributing the blows of the projectiles over a greater weight of armour.

* Paper by M. Canet, Junior Institution of Engineers, 1907.

Another important difference lay also in the method of working the guns. It has been the custom for many years in the British Navy to take up the recoil of the guns by hydraulic buffers, and to use hydraulic pressure to run out the guns again. The French introduced springs, which were compressed by the force of the recoil. Again, hydraulic appliances are preferred in the British Navy for training and elevating the guns, but our neighbours across the Channel prefer electricity. The latter has been tried in the British Navy, the most notable example being one of the super-*Dreadnoughts*, but the experiment has by no means given satisfaction.

Even more striking differences appeared in the matter of the ammunition hoists, etc. The French battleships, M. Canet said, were equipped with hoists leading direct from the magazines to the guns, and there was the drawback that the guns had to be returned to a certain position to be reloaded, and the muzzle had to be depressed a few degrees below the horizontal to facilitate the loading, the projectile being pushed home with a rammer by the gun crew, whose strength was assisted by a compressed spring. The ammunition hoists on the English battleships, on the contrary, were made in two sections. The lower section raised the ammunition to a relay chamber, and the upper section carried it thence to the gun. This method is held to allow of more rapid firing, as a large supply of ammunition can be placed, prior to an action, in the relay chamber, and the store there, as fast as it is drawn upon, can be replenished from the magazines. It has also been held that in case of a shell bursting in the turret the danger to the magazine would be less, and in M. Canet's opinion the English method is superior to that of the French. Another matter in which he considered the English to have an advantage was in the manner of loading the guns. How this was done on the

12-INCH BREECH MECHANISM (CLOSED).

12-INCH BREECH MECHANISM (OPEN).

By permission of Messrs. Vickers, Sons & Maxim, Ltd.

INTERIOR OF A BARBETTE, SHOWING 12-INCH GUN, H.M.S. "CÆSAR."

Photograph by Gale & Polden, Limited.

French battleships has just been explained. The English gun crews could load the guns at any elevation. The ammunition was carried up in a curved hoist, so that it could be delivered at any point desired, and was pushed home by a hydraulic rammer moving with the gun.

Time brings strange revenges. At one period the French were the leading nation in the world in the matter of naval construction, and the English were content to copy the French designs. But in later years England has taken the lead, and not only France but the other maritime powers of the world have been glad to sit at the feet of Britannia and accept the instruction she has been able to impart. Some of these pupils, if pupils they be, have proved themselves exceedingly apt copyists and improvers, and are inclined to think that their own creations are every whit as good as anything this country can produce.

The superiority of the British methods alluded to by the famous French gun-maker were not lost upon French naval architects, and in some of the latest French battleships these methods have been copied. The rapidity of the fire of the big guns would thus, it was expected, be raised to two rounds a minute. Electricity, however, has been retained, as the French consider it to be better than hydraulic machinery for the loading of the guns and movement of the turrets, and more easy of repair in case of damage under hostile fire.

The size and weight of the pieces forming the breech mechanism of the modern guns of large calibre made compulsory the adoption of mechanical means for loading them. There was also the further advantage that machinery was less likely to make mistakes, or to suffer from the accidents which are bound to disable some of the crew in a naval engagement. In some of the earlier battleships, in which the large muzzle-loading guns

were fitted, the charge was raised to the gun-mouth by machinery worked by hand-power, and after it had been rammed home by the crew the projectile was inserted and rammed home also, obviously an impossible arrangement when it was sought to introduce rifled explosive shells. When guns were made too large to be withdrawn into the turrets to be loaded, they were loaded by being depressed so that their muzzles just entered a specially cut orifice in the deck in front of the turret, and the loading crew were able to do their work in safety. The drawback to this system was that the gun had to be brought back to the same position for loading, then revolved with its turret once more to the direction in which it was to be discharged, and aimed afresh before its missile could be sent at its mark. The chief advantage of this system was that the gun required a smaller, and consequently less weighty, turret for the protection of its crew. The introduction of the breech-loader enabled the guns to be loaded in greater security, with greater speed, and without interfering with the aim or training of the gun, thereby rendering a more rapid fire possible. Ammunition hoists brought the charge and projectiles right into the turret or barbette more expeditiously and with greater precision than the best-drilled crew, and the men had simply to load the weapon and fire it. The human element came in here, however, in all its uncertainty, and, in spite of the greatest possible care, accidents occurred. A charge or a shell was dropped or caused to explode in some way, and disastrous were the results. Again the necessity for the mechanical appliances caused them to be forthcoming. The projectiles and charges for fighting purposes, which naval strategists declared to be necessary in ever-increasing size and weight, and the greater rapidity of fire which was demanded, made it impossible for dependence on hand power to be retained. After various

experiments, both steam power and electricity being tried, hydraulic power was introduced, and has proved more suitable for the purpose than any other method. Now the heaviest projectiles, weighing half a ton or more, are lifted with the greatest ease and exactness to the required position by hydraulic power, are pushed into their places by the same power which does a like office for the charge of explosive, closes and fixes the breech, and does not desist until its task is finished. In the latest appliances, the machinery is made interlocking, so that, at least in the system introduced lately by Messrs. Vickers, no one operation connected with loading the gun can be performed until its immediate predecessor has been accomplished. With a view to securing more rapid and accurate fire this firm has introduced a modification of the breech mechanism by what is known as a "pure couple." The hydraulic breech mechanisms just alluded to are used for the largest guns, such as the 12-inch weapons, and have also been installed on the Japanese ships for the 10-inch guns. The guns can be loaded at the required angle of elevation, the advantage claimed for this being that the sight can be kept on the target all the time.

The pressure to which guns are subjected when the charge explodes is enormous. One reason why they do not burst is that they have not time to do so. How rapidly the pressure arises against the sides of the gun and then against the projectile to expel it from the bore, was shown by experiments which Sir Andrew Noble conducted some time ago with a 6-inch gun of 100 calibres length of bore. Practically instantaneously with the ignition of the charge, that is to say in about the four-hundredth part of a second, a maximum pressure against the interior of the gun of 22 tons per square inch was reached, but this declined to about 13 tons per square inch in

about the twelve-hundredth part of a second more. But by that time the projectile had left the gun, and was rushing, faster than the eye could follow it, towards its mark.

The English 12-inch (Mark IX.) gun consists of a steel tube, wound practically from end to end with layer after layer of steel ribbon or wire of very great tensile strength. This tube is known as the A tube, and may be called the hollow heart of the gun. As much as a hundred miles of wire will be used for one of these guns, and, of course, for the newest guns, the 13-inch weapons, such as have been placed in the latest super-*Dreadnoughts*, or the 15-inch guns which it is said will be placed in the *Dreadnoughts* of 1912 or the year after, the amount is a great deal more. The greatest thickness of layers is placed round the breech of the gun, where the strain is most severe, and each succeeding layer is wound on with increasing tension, though to the ordinary observer the first layer seems to fit so tightly that nothing could be tighter ; but the gun makers know better. All along the chase or fore part of the tube another tube, called the B tube, is shrunk on to ensure that it shall be the tightest fit possible. Then, over a portion of the B tube, and also over a portion of the winding, that part of the gun known as the breech jacket is shrunk. Apparently everything is so strongly fixed together that nothing can cause the parts to separate, but the gun makers know this is not so, for into this jacket a bush is screwed to prevent any movement of the A tube, so far as the jacket is concerned. The A tube itself contains a thin steel inner tube inserted from the breech and fixed in position by the breech bush. It is this inmost tube which has to bear the wear and tear caused by the firing, and suffers from erosion, due to the gases generated by the explosion of the charges, and has to be replaced by a new tube when it is no longer fit for service.

THE 12-INCH GUNS OF H.M.S. "NEPTUNE."

Photograph by Stephen Crabb, Southsea.

Gun makers have always responded cheerfully to the challenge to penetrate the hardest armour of the time, and have succeeded in producing weapons which are able to penetrate any armour now carried. The problem at present is to increase the range at which the penetrative power may be exercised. This can only be attained by the increase in the length of the gun and the use of explosives developing higher pressures in order to obtain higher velocities. The British gun of 45 calibres and 9.2 inches diameter is about to be superseded by one of 50 calibres, and the 40-calibre gun carried in some of the latest ships is being superseded by the 12-inch gun of 45 calibres.

Twelve-inch guns of 45 calibres and 10-inch guns of 50 calibres have been installed in the new ships, built at Elswick recently, for the navies of Japan and one of the South American States.

Greater length means a greater muzzle energy, higher velocity, and increased power of penetration. The latest guns, too, have shown that the manufacturers have been considering the advisability of effecting a certain amount of redistribution in the thicknesses of the different parts of which the gun is built, notably the tubes, wires, and jackets, and the adoption of a uniform type of rifling. The theory was that the rifling should be increased as the grooves passed down the tube, so that a gradually increasing twist should be given to the projectile, but it is now held that no advantage is obtained by this method, whatever may have been the case in the past, and that the uniform rifling will give better results as to accuracy, muzzle energy and velocity, and inflict no greater strain upon the gun or shorten the "life" of its tube. The trials already made have shown that uniform rifling for modern high velocity guns has resulted in giving greater range and greater accuracy in shooting.

The war between France and Germany in 1871 brought machine guns into notice. Great things were expected by the French of the *mitrailleuse,* and some of the patriotic Paris newspapers at the time published glowing prophecies of the number of Germans each gun could be depended upon to kill in a few minutes, with the result that, according to their calculations, there would be no Germans left after a few days to continue the war. But events turned out otherwise ; the *mitrailleuse* failed, and the Germans were victorious. This machine gun was very defective, and served to advertise by contrast the Gatling, Nordenfeldt, Gardner, and Maxim automatic guns, named after their respective inventors. Of these the Maxim has been so improved that it is considered to be superior to any of the others. The machine guns fire, according to the number of their barrels and their calibre, from four hundred to six hundred or more shots per minute, at a range equal to that of the best infantry rifle, and can be sighted with deadly accuracy.

CHAPTER X

WARSHIPS OF THE TWENTIETH CENTURY

Two classes of vessels stand forward prominently as the products of the twentieth century. One is the *Dreadnought*, or all-big-gun one-calibre type of battleship, the other is the submarine. The fact that both are the result of the slow developments of centuries does not render them the less the products of the last few years. Both are untried in battle, and they are regarded as preparing the way for the introduction respectively of surface and under-water warships, the power of which is conjecturable only. Associated with both is the torpedo. The dream of a submarine which shall travel faster than a surface vessel of the same size is never likely to be realised, provided that the surface vessel is built for speed also, for the simple reason that the vessel travelling on the surface has only about a third of its surface in connection with the water, whereas the submarine has its whole surface submerged, and has three times as much friction against the water to overcome. Hence, a lightly armed, very fast vessel is regarded as likely to play an important role in the navy of the not distant future, and finds its representative in the destroyer of to-day.

The submarine and the destroyer owe their existence to the battleship's greatest enemy, the torpedo. All three vessels carry that weapon, and any two of them may combine against the third. The spar-torpedo was such an unsatisfactory weapon at best that it had either to be abandoned, save under most

unusual circumstances, or improved out of all recognition. The possibilities of the torpedo itself were so great as to compel its retention, and the startling proposition was made that torpedoes should be fired by under-water guns at a distant ship. The blowing up of the *Albemarle* in the American Civil War showed what could be accomplished by a small fast steam launch. If this could be done with a spar-torpedo, how much more destructive would a torpedo be which could be directed against a hostile vessel from a small fast launch which could approach to within an effective range, and then turn and make a rush for safety from the gun-fire which might be brought to bear in her direction. Several torpedoes of one kind and another have been designed, but they have all had to give way to the Whitehead torpedo. The inventor is stated to have derived his idea in 1864 from a fire-boat designed by an Austrian officer, who thought of loading a small boat with explosives, to be fired by a pistol connected with protruding spars which should strike the vessel attacked, while the fire-boat itself was to be propelled by a screw driven by clockwork. Whitehead improved on this by making his boat of iron, and able to travel under water for a short distance at a speed of six knots. Its explosive was a few pounds of dynamite. By 1870 he had improved this to a torpedo having a speed of eight knots, a range of 400 yards, and a charge of 76 lb. of gun-cotton. The modern Whitehead torpedo is a wonderful piece of mechanism, so wonderful that to the ordinary spectator it seems almost endowed with intelligence. To see it lying in its cradle ashore it is simply a beautifully polished smooth steel cylinder. The fore end is blunt and with an innocent-looking steel spike projecting from the centre of its rounded front, but it is this spike which strikes the object aimed at and causes the ignition of the explosive an inch or two behind

A TORPEDO, DISCHARGED FROM A DESTROYER, TRAVELLING BY ITS OWN ENGINES TOWARDS AN ARMOURED BATTLESHIP

it in the head of the cylinder. The torpedo has a fine run aft for about a third of its length, and at the after end are two vertical and two horizontal rudders, and two screws revolving in opposite directions. It is some time since compressed air was adopted as the motive power. The efficacy of the compressed cold air has been increased to an extraordinary degree by the introduction of an apparatus for heating the air. A torpedo fitted with a heater can travel over double the distance at a given speed and the same expenditure of air that a torpedo without a heater can. "If a torpedo be run for the same distance with a heater as a similar torpedo without a heater, a 100 per cent. gain of power would be realised by increasing the speed, and at a range of 2,000 yards this increase is from 26 knots to 33.5 knots, the highest which has ever been realised with a torpedo over a range of 2,000 yards."* The newest form of torpedo is that in which hot air instead of cold air is used.

In the case of the latest pattern 18-inch Whitehead torpedo, a speed of 28 knots for 2,000 yards, or 34½ knots for 1,000 yards when using the ordinary cold air, has been obtained. For longer distances, such as 3,000 and 4,000 yards, the speed is proportionately less, falling to about 20 knots for the 4,000 yards range. When using the heater, "the same torpedo maintains a speed of over 40 knots for 1,000 yards, 37 knots for 2,000 yards, 30 knots for 3,000 yards, and 27 knots for 4,000 yards. The speeds are quite extraordinary, as they represent exactly 100 per cent. more power from the engines, and it is further pointed out that the heater is extremely small, simple, and burns any ordinary lamp oil, and is capable of being fitted to practically any existing type of torpedo. The Admiralty has never been slow to adopt improvements in the torpedo armament of the

* *The Times.*

fleet, and for years Great Britain has led in the matter of submarine tubes for firing torpedoes."*

The explosive carried, usually gun-cotton, weighs 200 lb. An ingenious arrangement of gyroscope, valve and pendulum causes the torpedo to remain at the required depth, and to return to it if it should be diverted from it.

There have been several attempts to solve the problem of directing torpedoes by means of wireless telegraphy. The great drawback, however, has been that the receiving apparatus which the torpedo had to carry was outside it and must appear above the surface of the water, and was, therefore, liable to be sighted and shot away. The same objection has been raised to the equipment of submersible torpedo boats with "wireless." Of recent years a torpedo has been contrived which the inventors claim can be directed by wireless telegraphy, and as there seems no reason why the principle applied cannot be improved and extended to submarines and submersibles, the utility of these under-water craft may be augmented to an inconceivable degree. The "Actinaut" is the name of the torpedo, and the jet of salt water which it ejects serves not only to indicate the position of the torpedo, but is an "indestructible receiver for the electric waves."†

SUBMARINES

Submarine warfare and exploration are no new ideas, but in the past as in the present, the great difficulties have been to ensure the provision of sufficient power for rapid propulsion, and to keep the air pure enough for the crew to breathe for a long journey under water.

Efforts at submarine warfare seemed to have been made many centuries ago, but none of the contrivances then used

* *Engineering.* † *Illustrated London News*, June, 1903.

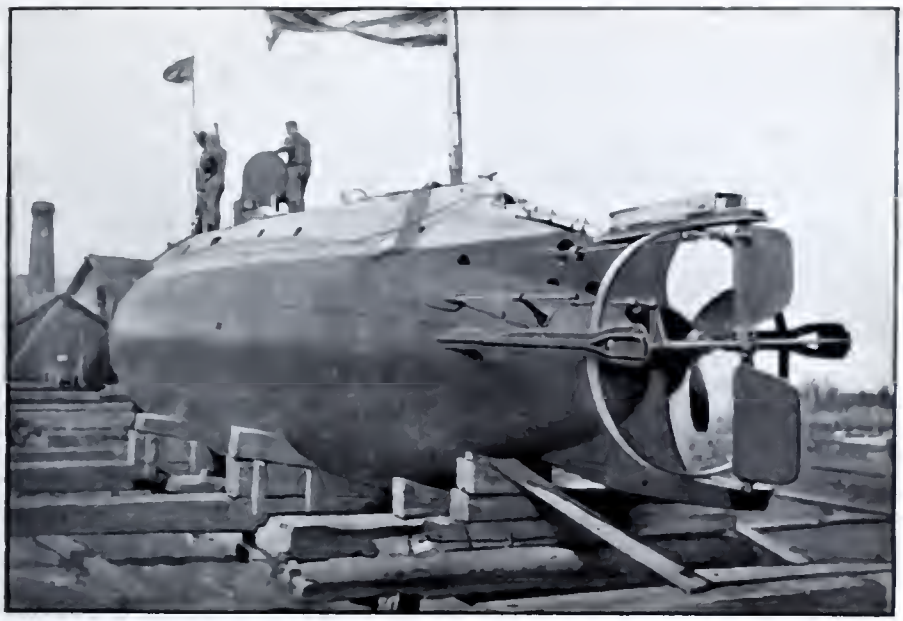
had any fighting value, and were more interesting as freaks than in any other capacity. It is unnecessary to attempt even to summarise all the schemes which early and late inventors evolved to render possible under-water attacks upon an enemy's fleet. The problem was as fascinating seven or eight hundred years ago as at the present time. Most of the alleged mediæval inventions probably never got beyond the imaginative or paper stage, and however wonderful the inventors' theories or written descriptions may have been, even when embellished with weird illustrations showing the contrivance at the bottom of the sea, it is not recorded that any of the submarines achieved any actual success whatever. One of the earliest submarine descents which is supposed to have been made was that of Alexander the Great, who is mendaciously represented to have been lowered to the bottom of the sea in a glass barrel, too small for him to stand up in, with a smoky oil lamp or two, and an animal which might have been a dog or a cat (it is difficult to say which the artist intended) for company, the circumstances being such that he could not have failed to be asphyxiated in a very short space of time. It appears, too, that he wore a crown and his royal robes on that occasion, so that he evidently visited Neptune in state.

As early as the year 1190 a man is said to have constructed a diving boat of leather. Numerous suggestions were made to enable men to go under water in order to bore holes through the sides of an enemy's ships, which, considering the thickness of the planks, must have been a somewhat laborious undertaking. The Barbary corsairs are stated to have used some sort of submarine explosive against the ships of their opponents, but this explosive or combustible was most likely Greek fire.

William Bourne, who served in Queen Elizabeth's navy, is said to have had a submarine boat which could have been made

useful, but there are no records in existence to show that the experiment ever took place. An interesting feature of the suggestion was that he proposed to sink or raise the vessel by admitting and expelling water. About the middle of the seventeenth century, a Dutchman is said to have invented a boat which travelled under water from Westminster to Greenwich, and it is even asserted that it carried passengers, in addition to twelve men at the oars, and that the air in the interior of this vessel was purified by a "chymicall liquor." A Royal Warrant, dated June 29th, 1626, ordered the delivery of "360 fforged iron cases with fireworkes, 50 water mynes, 290 water petards, and two boats to conduct them under water, for H.M. special service to goe with the fleete."

Two worthy friars of the Order of Minims turned from their spiritual contemplations to devise a submarine, and they appear to have been the first to suggest that it should be built with both ends alike, and pointed so that it could move either end foremost; it was to be given wheels to move along the sea floor, and to be propelled by oars. It was even to carry guns, to be fired through holes in the side. Another inventor in the seventeenth century waxed so enthusiastic over his submarine, that, besides pointing out its advantages in all manner of possible and impossible circumstances in time of war, he represented that it should be used for submarine hunting parties, who might have great sport shooting the fish as the boat went along. A Frenchman named De Son, built in 1663, at Rotterdam, a vessel about 72 feet in length, circular, and running to a cone at each end, by which he promised, but did not perform, great things. A few years later a boat was designed by the Abbé Borelli to travel under water, his idea being that the boat should rise or sink according to the amount of water admitted through holes in the hull to skins provided



THE "HOLLAND" SUBMARINE.

THE "GOUBET" SUBMARINE.

for the purpose. Bushnell, an American inventor, had a vessel he called the *Turtle*, which seems to have been shaped more like an egg. It floated at the surface of the water with the pointed end downward, and had a small screw propeller, jutting out at one side. On the opposite side of the body of the vessel was a magazine containing about 150 lb. of powder. This magazine was detachable from the inside of the ship, and was fastened by a rope to a powerful screw which the inventor intended to drive into the hold of the opposing warship, and then make the best of his way to safety, leaving the magazine attached to the screw. He was more anxious to find someone to make the attack on the British ships than to do it himself.

Probably the first really successfully designed submarine was that of Robert Fulton, the American, who submitted his plans of the *Nautilus* to the French Directory in 1797. His first boat was tried experimentally on the Seine in 1800. His next boat had iron ribs, and was copper-sheathed, and was shaped like a very long egg; it was fitted with a small hinged mast and a bat-wing sail, so that it could be used for surface navigation if necessary. He made a few descents in the Seine with success, but at no time stayed under water more than twenty minutes. Still, the experiment was held to be sufficiently promising for the boat to be tried at Brest, where he failed in his attempts to do any damage to the English ships of war. A preliminary experiment, before that against the English, was successful. On the British side, a so-called catamaran was contrived, by which it was intended to blow up the French ships at Boulogne. The catamaran consisted of a framework in which one man should sit immersed up to his arm-pits, and should paddle himself along under cover of darkness, and tow a floating box of powder to be exploded by clockwork in so many minutes, this affording him time to

paddle away in safety. This floating mine or torpedo was to be fastened under the counter of the wooden man-of-war. Fulton is supposed to have had a hand in this, but the attack when it was made ended in an absolute failure, the catamarans making the attack being mostly blown up, while those vessels against which it was directed suffered no harm whatever. Upon his return to America, Fulton constructed a submersible called the *Mute,* which was to fire "Colombiads," or under-water guns. Her inventor died during the course of her trials, which, however, did not reveal anything to show that the boat would have been other than an absolute failure as a warship. Though the British and the French naval authorities were strongly opposed to submarine warfare for a variety of reasons, American inventors continued their experiments. A diving boat passed under the British 74-gun ship *Ramilies* three times, and at last got close under the vessel, and tried to fasten a clockwork mine to it by means of a screw after the plan Bushnell adopted, but the screw broke. Other attempts were made, and as there were then no means of discovering when a submarine attack was intended, the British officer in command placed a number of American prisoners on board his ships and notified the American Government that if any of the ships were blown up, the American prisoners as well as the crew would go with it. What was known as an American torpedo-pilot was really a large boat covered from end to end with a curved iron deck, above which was a small pilot-house or look-out chamber, which also served as a ventilator; the boat was propelled by paddle-wheels, and travelled so low in the water as to be practically awash, and towed a mine behind her. Some of these mines or torpedoes contained as much as six barrels of gunpowder. An Englishman named Johnson designed a submarine or diving boat in which he was to have rescued

the ex-Emperor Napoleon from Saint Helena, but Napoleon's death intervened.

Various inventions were tried at one time and another, and the misfortune is that in many cases the first experiment proved to be the last, for the contrivances were the inventors' coffins. Some of these fatalities were unquestionably due to the submarines being made to descend too low, when they gave way under the enormous pressure of the water.

The first effective submarine designed for war purposes was a cigar-shaped boat constructed by an American shoemaker named Phillips. The boat was built of iron and carried a colombiad, which could be fired through a port in the iron plating, and also a couple of torpedoes or mines. Numerous experiments with this boat were successful, but Phillips descended once too often.

A German named Bauer invented a diving boat, which scared the Danes badly in the war between Denmark and Prussia in 1848–50. At its second voyage it descended too far, but Bauer and his two companions escaped through the scuttle. Thirty-six years later the boat was fished up, and is now in the Naval Museum at Berlin. Failing to get any more money in Germany, and being suddenly dropped in Austria after the Court and Government had given him much encouragement, he came to England, where the Prince Consort became his patron. He designed a submarine, but his plans were altered by some of the leading engineers, ship-builders, and statesmen, who, whatever their skill in surface navigation and diplomacy may have been, knew next to nothing of submarine navigation. The consequence was that his boat as altered to suit their views was a failure, and the discredit was cast upon Bauer. Still believing that he was right, he betook himself to the United States, but the American Government,

probably finding that the local supply of inventors and submarines was a long way in excess of the demand, turned a deaf ear to all his suggestions. He went back to Europe, and the Russian authorities authorised him to construct his *Sea Devil* which, after numerous experiments, was sunk under circumstances never fully explained. He managed, however, in one of his trips with her, to enter Sebastopol harbour, to the great dismay of a Russian sentry who, seeing him gliding by night in a standing position along the surface of the water, took him for a ghost, dropped his rifle, and ran. The loss of his boat has been attributed to an order of the Russian Government that it should be deliberately sunk to get it out of the way.

The French boat *Plongeur*, launched at Rochefort in 1863, was cigar-shaped with the upper side flattened, and was driven by an engine deriving its power from compressed air. She was too long for her width to be of much use, and had no stability.

The first Confederate *David* has already been alluded to, and the Southerners were so pleased with the success that they ordered another. In five experiments the second boat sank five times, and drowned altogether thirty-five men. Before she went down the next time it was determined that she should attack one of the Federal warships. She was directed against the *Housatonic*, then one of the fleet blockading Charleston. The *David* was being navigated along the surface of the water instead of beneath, and her scuttles were open. The little vessel's spar-torpedo struck the warship in line with the magazine. Nothing was ever seen of the *David* afterwards, nor of her crew. The *Housatonic* went down, but nearly all on board were saved.

Though the *Davids* proved as destructive to themselves as to the enemy, they demonstrated as nothing else could have done that a small boat approaching noiselessly under cover

of darkness could destroy by means of mines or torpedoes a hostile ship.

The most inappropriately named submarine was the *Resurgam*, invented by an English clergyman named Garrett, for during an experiment off the Welsh coast, in 1879, it never returned to the surface after diving.

The first submarine as a locomotive engine of warfare was invented by John P. Holland, and it is to his boat, known as the *Holland the First*, that all the modern submarines and submersibles owe their parentage. It was a one-man affair, just big enough to allow him to sit down in it and work with his feet the paddle arrangement that turned the propeller shaft. It carried five small torpedoes, which could be placed outside through a chamber in the dome or conning tower, and were discharged by electricity. This marked the introduction of one of the means which made modern submarine vessels possible, for until it was discovered how to use electricity in this way, a clockwork arrangement was the only reliable method by which a torpedo could be exploded. The application of electricity rendered it possible to eject the torpedo a considerable distance from the ship, comparatively speaking, and by means of connecting wires discharge it when thought advisable. This vessel was only 16 feet in length. The second *Holland*, built in 1877, was only 10 feet long. A small gas or oil engine was introduced to drive the screw propeller of a third submarine built by Holland two years later. This boat was 31 feet long, 6 feet in diameter, and cigar-shaped. The experiments he conducted with it showed that it was impossible to depend on ordinary vision when travelling in any depth of water on account of the darkness. She carried a pneumatic gun discharging a 9-inch projectile, the range of the weapon being 130 feet. It was not until 1884 that Holland's fourth

boat appeared. In the following year he tried again with a rather larger vessel, 40 feet long and 7 feet in diameter, often called the *Zalinski*, because it was fitted with pneumatic guns of the type invented by an American army lieutenant of that name. Again there was a long silence in regard to Holland, until he submitted the designs of his seventh boat—the sixth was planned but never built—to the American Government, which had decided to adopt the under-water torpedo boat as a definite part of the navy. The *Holland the Seventh*, as designed and launched, was to be 85 feet long, of 100 tons displacement, and to carry three torpedo tubes and two steel armoured gun turrets. The Holland Company had meanwhile designed a vessel they considered much superior, and the Government consented to adopt it in place of No. 7. She was something like a porpoise, and above a semi-cylindrical hull carried a flat-sided superstructure, which has been one of the distinguishing features of the Holland type of submarines from that day to this. Her aerial torpedo was to carry 100 lb. of gun-cotton. After discharging it she was to dive, approach the vessel she sought to destroy, and fire her Whitehead torpedo. If this missed, she was to go under the vessel and discharge her after submarine gun immediately after passing underneath. The *Holland* was altered and improved, and when the French announced that they had become possessed of types of submarines and submersibles upon which dependence could be placed in time of war for destroying an enemy's vessels, the British Admiralty abandoned the attitude of scepticism and watchfulness combined it had maintained for so long, and ordered five boats from the Holland Company for experimental purposes. The experiments which were made with these boats resulted in the Government becoming possessors of what were known as the A class of submarine.

BRITISH SUBMARINE A 13.

Photograph by J. Sankey, Barrow.

BRITISH SUBMARINE C 22.

Photograph by J. Sankey, Barrow.

Very little has been revealed of the details of modern submarines, for if there is one subject more than another upon which the admiralties of the world are agreed, it is that they should not let one another know the secrets of the mechanism of these under-water craft. That, at least, is the theory, but it is very questionable if all the governments are not quite well informed as to the constructional details of each other's submarines, and probably know almost as much about them as they do about their own. The experiments at Barrow and elsewhere with the Holland boats and their successors have been responsible for the introduction of several classes of submarines, every one of which embodies improvements upon its predecessor. The five boats built for Great Britain at Barrow, in 1902, were 63 feet 4 inches in length by 11 feet 9 inches breadth, by 12 feet 1 inch depth, and had a surface speed of ten knots and a submerged speed of seven knots. The A class, which appeared in 1902, began with a vessel of 180 tons displacement, and 100 feet in length by 12 feet 8 inches beam. Larger vessels of this class were built from 1904 to 1907 of 204 tons displacement, but varying considerably in dimensions. The B class of 313 tons submerged displacement was introduced in 1903–4. These vessels were 135 feet by 13 feet 6 inches, and had a cruising speed of fourteen knots and a submerged speed of nine knots. The C class, which resembled the B class in many particulars, appeared in 1906–7, as did also the D class, but the latter were of 500 tons submerged displacement and of fifteen knots cruising speed. The five boats built on the Holland designs were each propelled by a 4-cylinder 190 h.p. petrol engine besides an electrical engine of 70 h.p. The armament was an 18-inch torpedo tube in the bow, and each carried five torpedoes. These vessels were divided into seven compartments. The deck was 31 feet 4 inches by 4 feet 5 inches.

There were two diving rudders at the stern, and the conning tower, of 32 inches diameter, was formed of 4-inch armour. The A type, the first of which sank in March, 1904, off Spithead, had a 12-cylinder 600 h.p. gasolene engine. The B type had engines of 850 h.p., and could carry 15 tons of fuel structurally, and were provided with a forward superstructure. The D type have heavy oil engines, and can carry 15 tons of fuel. Yet another and more advanced type of submarine is stated to be under consideration and possibly under construction. It is to be larger, according to report, than any existing submarine, and is to carry a gun, which it will come to the surface to discharge. Is this to be the forerunner of a new cruiser, to be equally at home and equally dreaded, whether it be operating at the surface or beneath the waves, advancing stealthily upon its foe ?

The Japanese, when they decided upon importing some submarines from this country, had two specially built at Barrow. It was not thought advisable to send them under their own power, or in tow of tugs, to the Far East, so a special vessel was built for their accommodation. For two-thirds of her length her main deck could be removed and her bottom was constructed to permit of the two submarines lying side by side. In order to get them on board, this steamer, which was called the *Transporter,* was sunk in dock at Liverpool, the submarines were floated into place and the water was pumped from the dock, and, of course, from the steamer also. As it subsided, the submarines were carefully adjusted in their cradles, and when this work had been completed, the *Transporter* with her strange cargo returned to Barrow in order to be prepared for the voyage to Japan.

It is necessary, however, to consider what other nations have done in connection with the submarine, long before the

SUBMARINE D1, WITH WIRELESS TELEGRAPH MAST.

Photograph by Stephen Crabb, Southsea

Holland was adopted by the British Admiralty. A Swedish inventor, Dr. Nordenfeldt, who had given a great deal of attention to the subject, was attracted by Mr. Garrett's method of what was called "bottling up" the steam engine, so as to permit of the vessel diving under water. The first *Nordenfeldt* was cigar-shaped and 64 feet long, and was remarkable in one respect, for she was the first to carry a tube for discharging Whitehead torpedoes. She underwent in the presence of Royalty a fairly successful trial on the first day, and was ultimately purchased by the Greek Government. In 1887 Dr. Nordenfeldt and Mr. Garrett designed boats with screws placed on top, for regulating the ascent and descent, and the torpedo tube of each was carried at the outside of the bow instead of inside. One of these boats was taken by Mr. Garrett to Constantinople, where she was put through numerous evolutions in the presence of the Sultan himself and the greater part of the population of that city. The engineer and Mr. Garrett understood their work perfectly, but the same could not be said for the Turkish crew who were told off to be drilled in its manipulation. They knew nothing of submarines and did not want to learn, and maintained their obstinacy to the utmost. The trials took place in June, 1887. The Turkish boatmen simply would not keep out of her way, until one of them navigated his empty barge too close to the *Nordenfeldt*, whose revolving propeller knocked such a large hole in the barge's bottom that it was as much as the boatman could do to get it to the shore to save it foundering. After that the *Nordenfeldt* was allowed more room. The first time, so far as navigation was concerned, she was tried she was a success, but directly her stability was altered by the discharge of her Whitehead torpedo from the bows, her trim was changed very materially, and it was even thought possible that she might go down

stern first. However, the Turks bought her and added her to the collection of naval purchases of which they could make little use. A later submarine was built by Nordenfeldt, but proved no more stable, horizontally, than the other. It was purchased by the Russian Government, and was lost on the way to the Baltic.

The French have seemed to find an extraordinary fascination in submarine navigation. It was very great before Jules Verne published his fascinating romance, "Twenty Thousand Leagues Under the Sea," and became even more enthusiastic than ever. Of the early French experiments it is not necessary to say much. One of the first of the reliable French submarines was the *Goubet,* 10 feet in length, 6 feet high and 3 feet wide. This vessel was succeeded in the estimation of the French naval authorities by the *Gymnote,* which proved as remarkable a forerunner of a type as the *Dreadnought* did of the new type of battleships, and, like the *Dreadnought,* she has been steadily superseded by improvements upon her design. The *Gymnote* was designed by M. Gustave Zédé, although the credit of suggesting her in the first instance is sometimes ascribed to M. Dupuy de Lôme. She was launched in September, 1888, and was cigar-shaped. She displaced about 50 tons with dimensions of 59 feet in length, 6 feet in depth, and 5 feet 7 inches in breadth, and her electrical motor was supplied with the necessary power from a large installation of accumulators. Her conning tower was telescopic, and she had a periscope to enable her commander to take observations without coming to the surface; she was one of the first vessels, if not the first, to be fitted with a periscope or optical tube, the principle of which is that a mirror placed at a certain angle above the tube has its reflection reproduced by another mirror placed entirely parallel to it at the bottom of the tube. She

THE "TRANSPORTER."

Photograph supplied by Messrs. Vickers, Ltd.

U.S. GUNBOAT "PADUCAH."

Photograph [illegible]

carried two Whitehead torpedoes. M. Zédé planned another submarine which was launched in June, 1893, and its electrical installation nearly poisoned its crew owing to the fumes given off. Another *Goubet* followed, but was so slow that the Government rejected her. Since then, especially in the last few years, the French Government has gone in for a singular variety of these vessels. Some of them have undergone marvellous tests with conspicuous success. But none have attempted such a feat as two British submarines have accomplished, viz., from England to Hong Kong. They were towed part of the way, and escorted all of it, but their own power was not allowed to be idle.

It is now attempted to propel French submarines by Diesel engines for surface work, and by electric motors for under-water work; the result of the experiment is not known at the time of writing.

The Russian Government is said to favour submarines of the Lake pattern, so named after its American inventor, of which a great deal is thought; and America is said to have adopted both Holland and Lake submarines. One Lake boat was provided with wheels, and went on a submarine motor tour along the New England coasts, and Mr. Lake finally offered to demonstrate the usefulness of his vessel by finding and cutting the cables of the mines protecting one of the American ports. This was more than the American Government could allow, so he had a cable laid across a harbour mouth, and having found it, severed it.

The Italian authorities have modified the Holland and French plans to suit their own ideas, and though their boats are said to have given excellent results, singularly little is known about them.

All makes of submarines and submersibles have to return

to the surface at fairly frequent intervals to renew the supply of fresh air, and have to approach it at even more frequent intervals in order that the navigating officer may see what are his surroundings at the surface, and, in time of war, whether it would be safe for him to bring his vessel up. The difficulty of finding his way about without revealing his whereabouts by exposing the periscope to view is one of the greatest the commander of a submarine has to meet, but it would be futile to say that the ingenuity of scientific inventors will not overcome even this difficulty.

TORPEDO BOATS AND DESTROYERS

When the *Iris* was given a speed of 18½ knots, many declared that the limit in speed, with a due regard to safety, had been attained. Much the same was said when Mr. Thornycroft brought out the *Lightning* in 1876, the first real torpedo boat ever built for the British Navy, which had a speed of 18½ knots. Now, however, the speed has been more than doubled, and the sea-going qualities of the vessels are so much better that there is scarcely room for comparison. In 1873 the same firm built for the Norwegian Government a small steamboat intended to be employed in torpedo work only. The *Lightning* was 87 feet over all, with a displacement on her trials of 28½ tons; now torpedo boats are a hundred feet or so longer.

A small torpedo boat built for the Russian Government by Messrs. Yarrow, in 1879, was considered to be the most formidable vessel of her class afloat. Her speed was 22 knots, and on 10 tons of coal it was estimated that she would be able to steam 800 miles at a speed of 10 to 12 knots. Her stem was formed to be a sharp ram, and from the conning tower to the stem she had a hood over her deck to throw off

THE EARLIEST EUROPEAN TORPEDO BOAT. BUILT FOR THE NORWEGIAN GOVERNMENT IN 1873 SPEED 18 KNOTS.

Photograph supplied by Messrs. [illegible], Ltd.

FIRST BRITISH TORPEDO BOAT, "LIGHTNING" SPEED 18 KNOTS BUILT IN 1876.

Photograph supplied by Messrs. [illegible]

H.M. TORPEDO BOAT NO. 79, BUILT IN 1886.

H.M.S. "VULCAN."

Photograph by J. Sankey, Barrow.

the water she might take over her bows. The two launching tubes for her Whitehead torpedoes were on either side of the bows. The theory was that the first torpedo should break through the nets or other guards, and that the second torpedo, discharged a few seconds later, should pass through the gap thus made in the ship's defence and attack the hull itself. A comparatively recent invention is a contrivance to be carried on the nose of the torpedo to cut through the net.

Torpedo boats had to have their "parent ship," or ship to which they could go for any repairs to be made when at sea. The parent ship was necessarily a floating torpedo boat factory, and, if the torpedo boat were not too large, could hoist her on board and repair her as effectually as if she were in dry dock or on the slips ashore, and lower her again to the water when the work was finished. The *Vulcan*, of 6,620 tons displacement, was launched in 1889 to undertake these duties, and also act as a laboratory in connection with the mining service. She had two powerful hydraulic cranes for hoisting in and out torpedo boats, of which she carried six on her deck for the assistance of the fleet she might accompany, and also had two counterbalancing barges and steam pinnaces. In order that she might be able to protect herself she was equipped with twenty quick-firing guns. Several "parents" or floating repair ships have been added to the Navy of recent years, and every one of them is as modern as science and money can make her.

Having a large fleet of cruisers and battleships, it has been the British policy of late years to arm them with a powerful secondary battery, especially designed to meet torpedo attack. It is not touching upon international or diplomatic questions to state that the very preponderance of the British fleet has rendered the risk of invasion of these islands exceedingly small, and the resources of this country have been, and are, so vast,

that the much-debated two-power standard—in spite of the numerous and contradictory estimates of comparative naval strength based upon it—has, on the whole, been maintained.

If the theoretical British frontier be the coast-line of a possible opponent, it is evident that vessels which can steam to an enemy's coasts and destroy his torpedo boats there are of greater use than the torpedo boats which can only operate along the coast-line, or venture to cross the seas in fine weather. This has been set forth as one reason why the British Admiralty of recent years has preferred destroyers to the smaller vessels.

The introduction of rapid-firing guns of great power and range is claimed by some naval authorities to have reduced very materially the effectiveness of the torpedo boat. Its speed has been doubled in a few years, but it is contended that with the improvement in guns this has been more than neutralised by the greater size it has been necessary to give the torpedo boats in order to provide sufficient space for the machinery and retain the vessel's sea-going qualities, as the increased size renders the vessel easier to hit. It must be remembered, moreover, that the anti-torpedo boat armament of a modern warship can fire as many as a hundred shots a minute, or several times as many as when torpedo boats were added to the world's fleets.

Some of the Continental powers have been quick to appreciate the value of the torpedo boat as propelled by internal combustion engines, among the most noteworthy examples being those built and engined by Yarrow for the Austrian Government. The "E," for instance, is 60 feet in length by 9-feet beam, and has a draught of 2 feet 8 inches. She has three screws, and her five sets of these engines give her a speed of $22\frac{1}{4}$ knots, in spite of her diminutive size, and her radius of action at 11 knots is three times what would be obtainable

HIGH-SPEED SEA-GOING TORPEDO BOAT OR GUNBOAT, PROPELLED BY INTERNAL COMBUSTION ENGINES. SPEED 23 KNOTS.

Photograph supplied by W[illegible]

U.S. DESTROYER "LAWRENCE."

Photograph supplied by the [illegible]

with vessels of the same size propelled by steam. Another, of the same length, has attained a speed, when light, of 25½ knots, and of 24 knots with a load of 3 tons, and her radius of action at full speed is 250 miles. A somewhat larger vessel from the same makers is 100 feet in length, with a beam of 13 feet 6 inches, and her internal combustion engines give her a speed of 23½ knots. The advantages, and they are very great, claimed for all boats propelled by powerful engines of this type over those propelled by steam engines, are that as the vessels have no funnels there can be no flaming from funnels, with its risk of betrayal of the vessel's whereabouts; that only half the engine-room staff is required, and that the range of action is three times what it would be under steam.

The development of the torpedo boat as a means of offence soon made it necessary for a means to be devised of defeating them. The torpedo gunboat was accordingly designed, the idea being that it should be able not only to act as a small cruiser, scout or gunboat, but by reason of its superior size, armament, and sea-going qualities should hold the torpedo boats in check. One of the earliest of these was the French *Bombe* launched in 1885. She was of 395 tons displacement, and was intended to have a speed of 18 knots, but being lightly constructed, proved a slow boat whenever there was the suspicion of a sea on. England followed suit with the *Rattlesnake* and others, of 550 tons, but they also failed to maintain their designed speed of 19½ knots. Improved gunboats followed, which, however, were not considered to be equal to the duties required of them, especially as by 1902 torpedo boats were built to travel at a speed which would leave the gunboats far behind.

This left the way open for the appearance of the torpedo boat destroyer, which has been described as the result of the

failure of the gunboat to perform its second purpose satisfactorily.

The destroyer was designed to be able to overtake torpedo boats by superior speed, to be of larger dimensions, and therefore able to maintain her speed in rougher weather than the torpedo boat could, and to be sufficiently powerfully armed to sink a torpedo boat or hostile destroyer by gun-fire. The destroyer was also to carry torpedoes, it being desired to take advantage of the great speed to deliver torpedo attacks upon cruisers and other large ships as occasion offered. The earliest British destroyers were the *Daring* of 237 tons, in 1893 the *Hornet* of 240 tons, and the *Ferret* of 250 tons, built respectively by Thornycroft, Yarrow and Laird, all three boats having a speed of 27½ knots; and about two years later the Palmer firm built at Jarrow the *Janus*, *Lightning*, and *Porcupine* of equal speed. With Thornycroft's *Boxer*, in 1894, the speed was brought up to 29 knots; and in the same year the *Desperate*, 280 tons, and the *Quail*, 305 tons—two odd names to be associated—were the pioneers of the destroyers of the 30-knot type, many of which attained to 32 knots. These were turbine boats, but the *Albatross* by Thornycroft, with reciprocating engines, also attained 32 knots in 1899. The last 30-knot destroyer had her engines fitted with forced lubrication on a special system, which overcame the difficulty of oiling the engines satisfactorily for running at the high speed necessary and was the first destroyer in the British Navy to be thus equipped.

No further advance of a sensational character was announced until the *Star* was launched from Palmer's yards, and she was surpassed very shortly afterwards by the performance of the little steamer *Turbinia*. This vessel was only 100 feet in length, and of 44½ tons displacement. The engines of the Parsons

STERN VIEW OF H.M.S. "SYLVIA," 30-KNOT DESTROYER, WITH COAL-BURNING WATER-TUBE BOILERS.

Photograph supplied by Wm. Denford & Sons, Ltd., Sunderland.

type of turbines, with which it was fitted experimentally, received the cold shoulder, which seems to be the fate of all innovations that do not come into the world through official channels. But the owners of this vessel and the proprietors and inventors of the engines adopted a method of compelling recognition as daring as it was successful. The occasion chosen was the naval review held in honour of the diamond jubilee of the late Queen Victoria, and shortly before the Royal Yacht arrived to pass between the rows of warships, this turbine steamer shot into the fairway and went at her utmost speed from one end to the other of the lines of steamships and the finest assemblage of warships the world had ever seen, and there was not in the whole British Navy one destroyer or torpedo boat present that she could not outdistance. Thousands of spectators witnessed the exploit, and the success of the turbine engine was assured from that moment.

The remarkable development in steamship propulsion this vessel heralded was represented in less than ten years by the fastest and largest steamships in the world, and the largest and fastest and most powerful battleships afloat. The builders' estimate of the power of her rotary engines was that for every ton of the machinery 72 h.p. should be developed, and though this seems to have been accomplished in the *Turbinia*, equally satisfactory results have not been attained in the large sea-going destroyers fitted with turbine engines, but the results were in advance of those obtainable with reciprocating engines.

It was not, however, until 1900 that the first turbine-driven war vessel was added to the fighting force of the Navy. The Admiralty had not been idle and as the result of numerous tests and inquiries made the great experiment which brought about the revolution in the propulsion of the world's fighting ships. The mercantile marine led the way, the Allan line

being the first to have Atlantic liners equipped with turbines. The Government watched the experiment carefully, and in spite of opposition from some influential quarters decided to try how turbines would act in a destroyer. This was the *Viper*, of 390 tons displacement. The hull and boilers were by Hawthorn, Leslie and Co., and the engines were by the Parsons Turbine Company. She astonished everyone by attaining a speed of 36.6 knots when running light, and from that time onward the development of turbines for warships has been one long series of progress.

The destroyers of the River class, begun in 1903 and completed in 1906, had displacements varying from 540 to 590 tons, but the speed of all of them was about 25½ knots. These were followed by the coastal destroyers, designed, as their name indicates, to operate as destroyers along the coast against any hostile torpedo boats, but now classed as torpedo boats. In the latter capacity their guaranteed speed of 26 to 27 knots would stand them in good stead, but as destroyers they were soon outclassed. Some of them were provided with turbines.

The announcement that the Admiralty favoured a speed of 33 knots evoked a chorus of disapproval. The Admiralty was supposed to have become obsessed by a craze for speed, to which everything must be sacrificed. All the old objections which had done duty at every increase of speed for years, and had been proved to be ill-founded, were revived, brought up to date, and launched against the Admiralty proposals. Again it was contended that a vessel travelling at that speed must inevitably founder if she should unfortunately bury her nose in a wave, and that the violent alternation of stresses as she travelled in a rough sea must cause her to break her back or buckle her decks without more ado. But the *Mohawk*, in 1907, came and conquered, much to the delight of everyone

H.M. TORPEDO BOAT DESTROYER "SWIFT." OIL FUEL.

Photograph by Stephen Crisp, Southsea.

H.M.S. "WEAR."

Photograph supplied by Palmer Shipbuilding Co., Ltd.

except those whose prophecies, as usual, were upset, and not only attained a speed of 34½ knots, but accomplished it in fairly rough weather in the wintry month of November of that year, and proved her soundness of construction and the possession of excellent sea-going qualities. An objection, which at first was supposed to be serious, was that to attain such a high speed her consumption of fuel would be so great that her radius of action would be greatly restricted. The contract under which the *Mohawk* was built by White, at Cowes, contained the stipulation that she should maintain a speed of 33 knots for six hours; at her trials, however, she averaged 34¼ knots. Her consumption of oil fuel on this occasion was 64¼ tons, and as she is fitted to carry 148 tons, her radius of action at this enormous speed is 435 knots, and at 14 knots, which is known now as the cruising speed, she is estimated to cover 1,500 miles. Though 270 feet in length she is only 25 feet beam. She is constructed entirely of high tensile steel, the tensile strength ranging from 37 to 40 tons per square inch. Her three screw propellers are driven by turbine engines, and it has been found that with oil fuel she can attain her full speed in less time than would be possible were her furnaces fed with coal. Her armament consists of three 12-pounder rifled quick-firing breech-loading guns, two of which are forward and one aft, and two revolving tubes on deck for firing 18-inch torpedoes. Another of the class, Thornycroft's *Tartar*, made 35.678 knots on the measured course, an almost equal speed on the six-hours' run, while the highest speed she showed was 37.037 knots, thereby establishing a world's record.

The same year saw the launch of the *Swift*, at Birkenhead. She has a displacement of 1,800 tons, and is the largest and fastest destroyer yet constructed. She is of a special type, a class by herself; her turbine engines of 30,000 indicated h.p.

give her a speed of 36 knots, and for armament she carries four 4-inch guns and two torpedo tubes. Not far behind her in dimensions and speed is the Japanese *Kaifu,* but a Russian destroyer building at the Putilov yard in Russia is to be of 1,300 tons, but with engines as powerful as those of the *Swift,* is expected to prove fully as fast, if not faster.

The ocean-going destroyers, built in 1909, have displacements varying from 880 to 1,000 tons, and a speed of from 33 to 34 knots, a typical example being the *Maori,* built by Denny at Dumbarton. The new naval force for the Australian Commonwealth includes some very fine destroyers, among which may be mentioned the *Yarra.*

A tendency has been manifest in some of the later destroyers to provide better all-round fighting and sea-going qualities than were possible in vessels like the *Swift,* in which speed was all-important. The *Beagle* and *Acorn* are considered to be good representatives of the compromise.

The bunker capacity of destroyers being very limited, and their consumption of fuel large, it is evident that the scope of their operations must be considerably restricted. At no time is it possible for them to be more than fourteen days away from their coal base. In case of necessity they might coal at sea, if coal storeships accompany the fleet to which they are attached. The adoption of oil fuel, which can be stored in the double bottom, may increase the range at which these vessels can operate, and if, as is expected in the near future, destroyers driven by internal combustion engines are adopted, their range of action will prove more extensive still.

German and British rivalry in the production of faster destroyers and torpedo boats has resulted in the production of two types, each peculiarly suitable to the country to which it belongs ; the British vessels have been designed rather for

H.M. TORPEDO BOAT DESTROYER "TARTAR." TURBINE DRIVEN. SPEED 35 KNOTS.

Photograph supplied by Messrs. Y. T[illegible] & Co., Ltd.

H.M. TORPEDO BOAT DESTROYER "MAORI"

Photograph supplied by H. Pe[illegible] & Sons, Plymouth

the offensive, on the principle perhaps that the truest defence is the swiftest attack, while the German boats have become torpedo boats rather than destroyers, and though capable of performing the duties of both roles, are considered by British experts to be less destroyers than the British boats, which are admittedly destroyers first and torpedo boats afterwards. By 1909 the tonnage of the British destroyers had reached 950 tons, the speed being 27 knots. In that year, too, the Admiralty standardised its vessels instead of leaving the contractors to design their own craft. Oil fuel was tried in the small boats of these classes in the British Navy in 1904 and for three years subsequently, but was dropped, only to be taken up again in 1909, in which year Germany also experimented in this direction. The armament of the British and German ships shows that the destroyers of the latter are meant to be torpedo boat destroyers, though it is contended that they could be more heavily and effectively armed still than they are without interfering with their sea-going qualities and speed. The British boats have probably the greater gun power, while the German torpedo boats have the better torpedo power.

The scouts were a class introduced early in the present century, intended to combine the advantages of a fast gunboat with the speed of a small cruiser and the activity of a commerce destroyer. One of the best examples is the *Adventure*, launched in 1904, of 2,940 tons, whose engines of close upon 16,000 h.p. under forced draught give her a speed of 25.4 knots. She is, moreover, powerfully armed for a vessel of her lightness and speed, as she has ten 12-pounders and eight 3-pounders. The Americans in 1907 brought out the remarkable scout cruiser *Salem*, built by the Fore River Company. She was a 24-knot vessel, and though only of 4,640 tons displacement fully loaded, was given a freeboard of 34 feet at the stem, 19 feet

$8\frac{1}{4}$ inches amidships, and 21 feet 6 inches at the stern, or higher than that of any vessel then in the American navy, in order to give her excellent seagoing qualities in all weathers, and a wide range of stability. She was built of steel throughout, carried two torpedo tubes, and is heavily armed.

The crushing defeat of the Russians by the Japanese in both the naval engagements of the war was brought about by the superior long-range firing of the Japanese, whose big guns played havoc with the Russian vessels.

The Battle of Tsushima resulted in the "all-big-gun one-calibre battleship of high speed." How this came about has been admirably demonstrated by Lieut.-Commander Simms, of the United States Navy, and chief of the American naval artillery department, in a remarkable report on the battle and its influence on shipbuilding.

"Experiments have shown," he wrote, "that it is exceedingly difficult to hit an enemy at long range when the range is changing rapidly. This is, of course, not true at short range, but at long ranges half the danger spaces—those at which the gun sights must be set in order to hit—are so small, say 50 yards. The bearing of these facts on naval tactics is very important, since it means that, generally speaking, you cannot make many hits at long range while you are manœuvring. Conversely, you will not receive many hits at such a time, because, when at short ranges, the most dangerous position in which a ship can place itself is end-on to the enemy. It is usually assumed that this is equally true at all ranges; but this is not the case, provided the rate of change in fire is rapid. . . . From the point of view of the theory of gun-fire alone it would be unwise to think of building a man-of-war of any type having more than one calibre of gun in her main battery. In other words, it may be said that the abandonment of the

mixed battery ships in favour of the all-big-gun one-calibre ship was directly caused by the recognition of certain fundamental principles of naval marksmanship developed by gunnery officers."

There was no great heralding by trumpet-blast the arrival of the *Dreadnought*. The true significance of this vessel only became understood by degrees. The Admiralty kept its secret well: indeed, it may be doubted if an Admiralty secret has ever been so well kept before. A short paragraph in the papers was all that was vouchsafed for the edification of the public or the naval experts of other nations. It was known that a warship to bear the historic name of *Dreadnought* was to be launched, but the public took it for granted that it was an addition to some "programme" or other, and regarding modern battleships as too wonderful and too full of mechanism to be comprehended by ordinary mortals, was content to accept that much, and leave the rest to the experts. But the naval experts of the other powers were astounded when they learnt the march that Great Britain had stolen upon them. They appreciated to the full the importance of the new era in warship building which had been inaugurated, for they saw that England had a lead which they could not overtake, and that with her splendid resources she would be able to accept any challenge for rivalry for first position which any power might offer. The *Dreadnought* meant that any other warship afloat was already rendered out of date. Her gun-fire, as much by its weight as by the range of her guns, would enable her to pick and choose where and when and how she would fight, and her speed would enable her to prevent any ship, however powerful, from shrinking from a combat if the *Dreadnought* thought fit to insist upon one. It was even recognised that she was a match for two or three of the most powerful ships that could

be brought against her, for her big guns would be equal to theirs in hitting power, and their smaller guns would be ineffective at the range at which she could fight. Again, by concentrating a portion of her fire upon one of her antagonists she would be able to crush it, and then turn her attention to the other two with the odds as represented by gun-fire distinctly in her favour. Some enthusiastic adherents of the *Dreadnought* even went so far as to assert that she was equal to half a dozen *Lord Nelsons*, but the more extreme views of this nature were rather severely criticised. It was not only in the number of big guns that the *Dreadnought* exceeded all previous ships, but in their penetrative quality also. Compared with those of the *Majestic* they are of about fifty per cent. greater power.

Lieut.-Commander Simms, however, was by no means the only one or the first to hold the views explained in his report. They were entertained by many authorities in other countries, and especially in England, and the recognition by this country of the importance of the theory led to the secrecy with which everything connected with the *Dreadnought* was invested.

One notable change introduced with the *Dreadnought* was that she had no intermediate or secondary armament. She carried ten 12-inch guns as her main battery, and some smaller guns to repel torpedo attack, but whereas the *Lord Nelson* had twenty-nine anti-torpedo boat guns the *Dreadnought* had but five, depending rather upon her smaller armament of twenty-four 3-inch quick-firers (12-pounders), and in addition she had five under-water torpedo tubes.

A Parliamentary Paper issued at the time described the arrangement of her guns as follows :—

" In arranging for a uniform armament of 12-inch guns it became at once apparent that a limitation to the number of guns that could be usefully carried was imposed by considerations of the blast effect

H.M.S. "DREADNOUGHT."

Photograph by Stephen Cribb, Southsea

of the guns on the crews of those guns adjacent to them. It is obviously uneconomical to place the guns in such relative positions that the blast of any single gun on any permissible training should very seriously hamper the use of one or more of the remaining guns. While it is recognised that broadside fire is held to be the most important in a battleship, all-round fire is also considered of great importance, since it lies in the power of an enemy to force an opponent who is anxious to engage to fight an end-on action. In the arrangement of armament adopted six of the guns are mounted in pairs on the centre line of the ship; the remaining four guns are mounted in pairs on the broadside. These eight 12-inch guns—80 per cent. of the main armament—can be fired on either broadside, and four or possibly six 12-inch guns—or 60 per cent. of the main armament—can be fired simultaneously ahead or astern.

"In view of the mobility of modern torpedo craft, and considering the special chances of torpedo attack toward the end of the action, it was considered necessary to separate the anti-torpedo boat guns as widely as possible from one another, so that the whole of them should not be disabled by one or two heavy shells. This consideration led the committee to recommend the numerous and yet widely distributed armament of 12-pounder quick-firing guns of a new design and greater power than those hitherto carried for use against torpedo craft. In order to give the ship sea-going qualities and to increase the command of her forward guns a forecastle is provided giving the ship a freeboard forward of 28 feet, a higher freeboard than has been given to any modern battleship. The main armoured belt has a maximum thickness of 11 inches, tapering to 6 inches at the forward and 4 inches at the after extremity of the vessel; the redoubt armour varies in thickness from 11 inches to 8 inches; the turrets and fore conning tower are 11 inches thick, and the after conning tower is 8 inches thick. The protective deck varies from 1¾ inches to 2¾ inches in thickness. Special attention has been given to safeguarding the ship from destruction by under-water explosion. All the main transverse bulkheads below the main deck—which will be 9 feet above the water-line—are unpierced except for the purpose of leading pipes or wires conveying power. Lifts and other special arrangements are provided and give access to various compartments. Mobility of

force is of prime necessity in war. The greater the mobility the greater the chance of obtaining a strategic advantage. This mobility is represented by speed and fuel endurance. Superior speed also gives the power of choosing the range. To gain this advantage the speed designed for the *Dreadnought* is twenty-one knots."

Turbines were decided upon because it was held that their adoption conferred certain advantages which more than counterbalanced their disadvantages. Compared with reciprocating engines, they were said to be lighter, to have a less number of working parts, to work more smoothly and be more easily manipulated, and to be less liable to breakdown. They were claimed also to show a saving in coal consumption at high powers, and to require less boiler-room space and a smaller number of engineers to look after them. Another important consideration was that turbines could be placed lower in the ship. The point which chiefly occupied the committee was the question of providing sufficient stopping and turning power for quick and easy manœuvring. A series of experiments with pairs of sister ships, fitted respectively with reciprocating and turbine engines, and also at the Admiralty experimental works at Haslar, influenced the Admiralty in their decision in favour of turbines. The *Dreadnought's* bunker capacity is 2,700 tons, with which she could steam 5,800 sea miles at economical speed, or 3,500 sea miles at 18½ knots, due allowance being made for extra consumption in bad weather, and for a small quantity being left in the bunkers. Oil fuel was not taken into account in estimating the ship's radius of action, but a considerable quantity was arranged for and would, of course, greatly increase her effectiveness in this respect.

Another innovation in this remarkable ship was in the rearrangement of the principal officers' quarters. Hitherto they had been accommodated as far as possible from the conning

tower, where their most important duties were performed, but in this ship the admiral's and captain's quarters are placed on the main deck forward, near the conning tower. The officers' quarters also are placed forward, both on the main deck and on the upper deck. Ample accommodation for the remainder of the crew is available on the main and lower decks aft.

Space does not permit—and to attempt it would be out of place in a book of this character, which does not profess to do more than indicate the general lines upon which the world's warships have developed—of a detailed account of all the ships which have followed the *Dreadnought*. Some idea of the wonderful progress that has been made may be obtained from a comparison of the *Dreadnought* herself and one of her latest successors, the battleship *Orion*, in the matter of armament. The *Dreadnought* could fire on the broadside eight guns of 12-inch calibre, throwing projectiles of 850 lb. weight, her weight of broadside being 6,800 lb. The *Orion* has ten guns on the broadside having a calibre of 13½ inches, and throwing projectiles of 1,250 lb. in weight, the weight of broadside being 12,500 lb. Now, if we take the ships intended to be able to take their place in the line of battle since 1906, we find the evidence of development to be equally startling. The dimensions of the *Lord Nelson* and *Agamemnon* have already been referred to, and are of exceptional interest in this connection as showing the type of vessel the *Dreadnought* superseded. This vessel herself was exceeded slightly in displacement by the *Bellerophon*, *Temeraire*, and *Superb*, which had sixteen anti-torpedo boat 4-inch guns, as against the twenty-seven 12-pounders of the *Dreadnought*. The *St. Vincent*, completed in 1909, and her sisters the *Vanguard* and *Collingwood*, completed in 1910, are 500 feet in length by 84 feet beam, and have a displacement of 19,250 tons, and engines of 25,400 h.p.;

their armoured belt is $9\frac{3}{4}$ inches thick amidships, tapering fore and aft to $6\frac{1}{2}$ inches, while the armour of the barbettes is 11 inches in thickness, and the protective deck is $2\frac{3}{4}$ inches. They have the same number of big guns and torpedo tubes, but the number of the 4-inch anti-torpedo guns was increased to twenty, and they also had six Maxims. In 1911 the *Colossus, Hercules* and *Neptune* were launched, and showed a very great advance on those immediately before them. Their length was increased to 510 feet, and they were 86 feet in the beam and of 20,250 tons displacement, and their engines developed 25,000 h.p. Their armour was more powerful, as their water-line belt amidships was 10 inches thick, tapering to 8 inches forward and 7 inches aft; their armament was the same. These three ships were given conning towers with 11-inch armour. There were also launched in 1911 the *Orion, Thunderer, Monarch,* and *Conqueror,* built respectively at Portsmouth, Blackwall, Elswick and Dalmuir. These four vessels are so much larger and heavier than preceding ships of the all-big-gun type that they have been claimed as inaugurating another class. They carry ten 13.5 inch guns, which include the famous "12-inch A," in five barbettes, all of which are on the centre line of the ship. These four vessels are each 545 feet in length between perpendiculars, and 584 feet over all, and have a beam of 88 feet 6 inches. The weight of the *Orion* at launching was about 8,000 tons, and her estimated load displacement is 22,500 tons. Her engines, developing 27,000 shaft h.p., are Parsons turbines, driving four shafts and screws, each having a turbine for ahead and astern, the ship having a nominal speed of 21 knots, which is expected to be exceeded. She has eighteen water-tube boilers, and can carry, besides 2,700 tons of coal, 1,000 tons of oil in her double bottom tanks. Her armour varies from 12 inches to 4 inches. Under ordinary circumstances the arrange-

H.M.S. "NEPTUNE."

Photograph by Stephen Crabb, Southsea

H.M. SUPER-DREADNOUGHT "COLOSSUS."

Photograph by Stephen Crabb, Southsea

ment adopted for the guns would restrict their direct ahead and astern fire very materially, and in order to overcome this difficulty and double the gun-fire ahead or astern, the second and fourth pairs of guns are raised to fire above the others. Besides increasing the effectiveness of the end-on fire, it will also add materially to the weight of the broadside fire, as, the guns being on a different level, there will be less of what is known as the interference of one pair of guns with another, and the air will become clear the sooner so that the gunners will be able to take a more accurate aim than would otherwise be possible. There are also sixteen anti-torpedo 4-inch guns.

The *Orion* has about 2,000 tons more displacement than the *Neptune*, and this has enabled her to carry the heavier guns. She has one elevated tripod mast which is provided with wireless telegraphy apparatus. Her two funnels are of more than usual height, and steam is generated in a series of water-tube boilers. To summarise, by way of contrast, the armament arrangement of these ships, it may be said that the *Dreadnought*, the three *Bellerophons*, and the three *St. Vincents* have six 12-inch guns in three turrets on the middle line of the ship, and two in a turret on either wing. The *Neptune*, *Colossus*, and *Hercules* have their wing turrets *en echelon*, so that ten guns can be trained on either side. The *Orions* have all their guns on the centre line of the ship. Which of these systems is the best has been keenly debated. Experiments in gun-fire are being carried out to ascertain it, but the true test can only be warfare, and even then much will depend on the circumstances of the battle and on the men behind the guns.

The *Hercules* was the first of her class to be given only one mast. Of the centre-line turrets, one is forward and the other two are aft, and of these two the foremost can fire over

that aft of it. This arrangement of the turrets makes it possible for ten of these immense guns to be fired on either broadside. There are also twenty 4-inch quick-firers and three submerged 21-inch torpedo tubes. Her maximum coal capacity is 2,700 tons and she can also carry oil fuel in her double bottom. She is a sister vessel to the *Neptune* and *Colossus*. These three vessels are protected against attack by aerial warships.

Like all the rest of the *Dreadnoughts*, the *Neptune* was constructed in unusually quick time, only two years elapsing from the laying of the keel until she was ready for being commissioned. She has been described as a 30 per cent. improvement on the *Dreadnought*, but the rapidity of her construction made her a cheaper vessel than the other, her cost per ton of displacement working out at £86.85, as against £101.29 for the *Dreadnought*.

The *Monarch* took the water with a launching weight of about 11,500 tons, a record for a warship, after having been just a year on the stocks. This weight included the main structure, the boilers, funnels, funnel uptakes, casings, and a large quantity of auxiliary machinery and armour. Her eighteen boilers weighed 23 tons each, and her two funnels, which are 53 feet high above the upper deck, weigh 18 tons apiece. The deck-houses and bridges were also in place, and she was in other respects in a forward condition. The whole of the work was carried out in 220 working days. This shows what can be done in the private ship-building yards of this country. Builders of warships now find it more economical to put as much work as possible into the hull before launching it, modern dockyard methods rendering this comparatively easy. A great boiler is raised bodily and lifted into position without trouble, and even items weighing 20 to 30 tons or more are lifted and

deposited where wanted with no more trouble than if they weighed so many hundredweights.

Mention has been made in earlier pages of such splendid vessels as the *Hood, Trafalgar, Nile* and *Royal Sovereign*, all of which in their day, not so long past, were considered to be unsurpassed, and by some to be unsurpassable. Their fighting efficiency is as great as the day they were launched, yet these and many others, equally good vessels, have been removed from the list of the Navy as obsolete and ere long will retire ingloriously to the scrap-heap. All these vessels have been launched since 1890, and however much one may deplore that such fine ships should be discarded, there is no denying that they are hopelessly outclassed by the *Dreadnoughts*, and that a dozen of them would not be a match for one of the latest *Orions*. Yet more than one of them was hailed as the last word in battleships, and there were some who asserted that they would prove to be the last big armoured ships to be built, as torpedo craft and protected cruisers would constitute the navies of the future. But that prophecy was made before the Battle of Tsushima was fought, and the lessons it taught were learnt.

Protests by naval men against the relegation of these ships to the lists of the useless have been frequent, and it has been contended that some of these fine old battleships could have been sent to the Colonies to act as harbour-defence vessels. But the Colonies have shown no disposition to be satisfied with anything under the best that money can buy, and they have contended that if a ship be out of date it is no use to them, especially as any hostile power sending a ship out against them would probably send one of the best and newest and most powerful.

The compound armour produced in 1879 enabled the thickness of armour carried to be reduced to 18 inches, and proved

equal to the attacks of the 80-ton gun of the period, but was ultimately beaten by heavier guns and improved projectiles. All-steel armour was introduced in 1890, and was followed in 1892 by the super-carburising and subsequent chilling of the face of plates made of nickel steel. Five years later steel plates were made yet harder, until the 9-inch plate of the modern battleship was equal to a 13-inch plate of the early hardened type, or a 20-inch compound plate of the 'eighties, or a 26-inch wrought-iron plate of the 'sixties.*

The modern 12-inch gun, it has been pointed out, with a muzzle velocity of 2,859 feet per second, can penetrate the thickest armour on any of the ships of the *Majestic* class at a range of 12,700 yards; the ships of the *Duncan* class would suffer at about the same range; that of the *Ocean* class would be penetrated at 13,350 yards; and that of the *Formidables* at over 11,000 yards. The broadside water-line belt of any of these ships could be perforated by the same gun at any range up to the limit of observation. On the other hand, the primary guns of the ships of the classes named could only perforate the water-line belt of the *Dreadnoughts* at from 7,000 to 9,000 yards range, the former being the range of the *Oceans* for this purpose. The modern ship could smash the others without receiving a hit in return. Even if they did succeed in getting close enough to use their heavier guns and the 6-inch guns as well, they would be exposed to the risk of a much severer blow in return. This is not the only consideration. Rapidity of gun-fire has to be taken into account. The *Majestic's* four 12-inch guns can only fire six rounds each in ten minutes or twenty-four rounds in all in that time, and the other three classes named could fire forty rounds per ship in a ten minutes' action. The *Dreadnoughts* of 1906–7 could reply with 120

* "Two Centuries of Shipbuilding."

BRAZILIAN BATTLESHIP "MINAS GERAES," SHOWING DECK AND SUPERIMPOSED TURRETS.

Photograph supplied by Sir W. G. Armstrong, Whit[illegible]

rounds, and the latest type of *Dreadnought* with 150 rounds, using the 12-inch guns, and of course the disparity would be even greater with the newest guns.*

The rapidity of fire of the large guns has been greatly increased of late years, and compared with the destructive effects inflicted by some of the guns they have superseded, notwithstanding that the changes were not brought about without encountering some opposition, the new guns are held to have justified their selection to the fullest. The experiments made in firing on old battleships have shown what the guns then considered sufficient could accomplish, and as the muzzle velocity and muzzle energy and the other scientific data could all be calculated to a nicety, and the effects on certain constructions of armour when struck by projectiles of certain shapes and weights could be estimated approximately and verified by actual experiment, it became really a question for the gun-makers whether they could produce a weapon which, at the range at which modern actions at sea are likely to be fought in the future, would be able to penetrate the heaviest armour which could be placed on a battleship of known displacement. This problem has exercised the artillerists of all nations with naval aspirations, particularly those of Great Britain, Germany, Italy and the United States, and of recent years Japan. Austria has usually been content to follow the lead of Germany in this respect, and the other powers, such as the South American States, China, and the smaller European States, have had to content themselves with the advice of the experts in the gun-manufacturing countries, except when political necessities and diplomatic pressure have regulated their choice for them, to the financial advantage of the vendors. Some of the most powerful warships afloat have been designed

* *Engineering*, April 28, 1911.

by private firms, notably those built at Barrow, or on the Tyne, or at Liverpool, for the South American States, the *Minas Geraes* and her two sisters being conspicuous examples. These vessels have each twelve 12-inch guns, twenty-two 4.7 quick-firers, and eight 3-pounder quick-firers, and four torpedo tubes. Their displacement is 19,250 tons, their horse-power indicated 24,500, and their speed 21 knots.

The other nations made up their minds that they must follow the lead that England had set, and have *Dreadnought* ships as good as hers or better. The naval architects of the powers have since been engaged in a struggle to surpass each other and England in particular. The name-ship has been so much improved upon in recent designs that she is as inferior to the last of the super-*Dreadnought* battleships as the displaced pre-*Dreadnoughts* were to her.

One American legislator, unaware of the historical significance of the name of the *Dreadnought,* suggested at Washington that the United States should "go one better" by building the "United States warship *Skeered-o'-Nothing,*" with thirty or forty guns—a few big guns more or less apparently did not matter to this naval humorist—and let England see that there was a flag called "Old Glory" which could also brave the battle and the breeze. The suggestion was a sample of that peculiar humour, now, happily, almost moribund, in the Great Republic, and usually estimated at its proper value; it was taken seriously, however, in some quarters, and it was shown to be impossible to build a vessel which should carry forty guns larger than those of the *Dreadnought,* and be faster.

Modern American battleships have attracted more than ordinary attention by the daring character of the innovations the naval architects of that country have not hesitated to introduce. The armament of the *Kearsarge* and *Kentucky* was

extremely powerful, and its arrangement was unique. There were two turrets with walls 13 inches thick, each containing two 13-inch guns; and above each of these turrets was a smaller turret with 9-inch walls, in which were two 8-inch guns. This gave two two-storeyed turrets with four guns to each; either pair of guns could be fired independently of the other pair, but they could not be aimed independently, and when it was necessary to turn the turret all four guns had to go with it. This experiment, though apparently excellent in theory, did not prove satisfactory in practice, and the designs for subsequent vessels which were to have had similar turrets were altered. Other nations have not taken kindly to the idea, and have not adopted it, and too many objections have been raised to the proposal that the upper and lower turrets should be constructed so as to revolve independently of each other for this plan to be given serious trial. Some of the American vessels have been fitted with what are known as lattice masts, or miniature Eiffel towers. It is claimed for them that they are of great strength for their weight, and that they are less likely than the military mast or the tripod mast to be utterly destroyed by gun-fire. The naval authorities of the other powers are interested but not converted.

When the *Dreadnought* was launched, the Americans replied with the ships of the *Delaware* class, of 20,000 tons and carrying ten 12-inch guns. The French had done very little for some time in the building of big ships, seeming to prefer smaller ships in greater number, but they too fell into line and built the *Danton* and others. The *Danton* was built in four years, which contrasts favourably with the seven years spent on some French ships.

Germany, in constructing her modern fleet, had to bear in mind that the waters round her coasts are rather shallow,

but she has produced some splendid ships of great fighting power and high speed. She has some ships under construction more powerful than any at present in her navy, and one of these —the cruiser *Moltke*—is expected to be quite as good as anything England or America can show.

So great has been the demand for *Dreadnoughts,* that at the beginning of this year, for Great Britain alone, there were built or building no fewer than twenty-two, and arrangements had been made for laying down five more ; while for foreign powers there have been constructed, or were still in the builders' hands, up to January last, the enormous total of sixty. The average cost of these vessels has not been much short of a couple of millions sterling, and some have cost fully £2,300,000. The *Dreadnought* type has admittedly not reached its maximum development yet, and it may well be asked, where is it to stop ? At present battleships of a somewhat smaller type are being advocated.

What will be the type of the battleship of the future ? Revolutionary as have been the developments in the nineteenth century, great as have been the changes in the last twenty-five years, marvellous as has been the adaptation of scientific discoveries and appliances to the means for conducting naval warfare, it would be an idle boast for anyone to say that he can see finality. The dream to render war impossible by the introduction of some dread weapon has been entertained by many inventors, but never a one of them has seen its fulfilment. When steam-driven armoured warships were proposed, there were not wanting those who declared that henceforth fleets of wooden walls were doomed, and that naval war would become an impossibility. Yet the wooden walls have passed away, the nations unanimously adopted the newer methods, and the contingency of naval war must ever be provided for. The

heavily armoured iron ship, carrying few guns of enormous power, came; and when at last it was found that were the armour made much thicker the ship would sink under the weight of her own protection and armament, and that guns could be constructed to smash that armour, again the hope was entertained that the limit had been reached, that naval warfare had become an impossibility, and that the world's highways on the vast and beautiful ocean should be devoted solely to the purposes of commerce and peace. But science had already come to the rescue and dispelled the illusion before it was half-formed. Steel, at first gradually and then wholly, took the place of iron in the building of ships, the production of guns, and the manufacture of projectiles. Steel itself has been improved since it was made possible by the Bessemer process, and Harveyised steel, Krupp steel, and steel toughened with nickel or chrome or tungsten, or by what is known as the Simpson process, have all been tried and have all proved their value. The science of ballistics has made equal progress, and the development of the resources of marine engineering are little short of the miraculous. And the end is not yet!

There are guns in existence which at their maximum elevation will hurl a projectile weighing not far short of three-quarters of a ton a distance of 25 miles, and the projectile itself contains an explosive charge more powerful and destructive than the heaviest charge which could be placed in the heaviest gun which was fought in the Battle of Trafalgar. The whole fleet which bombarded Alexandria would be no match for the latest *Orion*, and the *Orion* herself at no very distant date will be removed from the list of effective ships as obsolete, or as having only a doubtful fighting value. Scientific development cannot be arrested, and the only hope is that some day the inventions for war purposes will have become so terrible that the dream

of inventors that they have made war impossible will be realised. In the meantime, science is seeking to surpass all its present achievements. The marine steam engine, of whatever type, will give way to the internal combustion engine of a type which will surpass all the existing machinery as surely as the best turbines are ahead of the old compound engines. The battleship of the future will have an armament surpassing in effective range and penetrative power anything at present afloat, and an armour as far in advance of the present steel armour as that is ahead of the compound armour it but lately supplanted. The adoption of the internal combustion engine will mean the removal from the ship's deck of the obstructions which now find a place there. With no furnaces, there will be no funnels. An armoured citadel, flush decked from end to end, has been prophesied as a coming type in the early future, with one mast for signalling purposes and to convey the wireless telegraphy apparatus, the necessary ventilators, and the conning towers as the only breaks in the smoothness of the deck. Submarine signalling, already in extensive use in warships and the mercantile marine, is being improved beyond all comparison with what it was a few years ago, and if the wireless apparatus be shot away it will still be possible for a ship to signal by the other method over a distance of some miles. Moreover, submarine signalling will enable an admiral to judge how an enemy's fire may be affecting a distant ship of his own squadron. Size will be another feature of the coming battleship, for in size lies one of the chief protections from the attack of the most insidious and most to be feared naval weapons of the present, as well as the future. The submarine ship will launch its torpedo at a greater range as the propelling machinery of the torpedo is strengthened, and, granted that the aim is true, the only hope the great warship will have of surviving the

explosion of the under-water weapon will lie in the number of compartments into which her dimensions will permit of her hull being subdivided or her double bottom to accommodate, thereby restricting the area of the damage and limiting the inrush of water.

The torpedo itself is destined to play a part more important than has yet fallen to its lot in war. Not only will it be launched from the tubes of the battleship or cruiser or destroyer at the distant foe, but it will be dirigible, controlled and steered by wireless telegraphy, and extra speed, or counter explosion, or gun-fire, or the disablement of the vessel sending it forth will alone be the means of rendering it ineffective. Torpedo nets may be of value when ships are at anchor or travelling slowly, but not at any other time.

The submarine will not be the only danger to be guarded against from an unexpected quarter. The aeroplane and airship will play their parts in the next naval war. Experiments have already been tried in starting a flight of an aeroplane from a platform at the bows of an American warship, and this being accomplished, it is not too much to anticipate that aeroplanes for purposes of observation or attack may become part of the equipment of every battleship or large cruiser. The flying machine will drop its bomb on the deck of the attacked vessel, if the aviator has the good fortune to aim sufficiently straight, but whether the dropped explosive will do much harm will depend on whether the deck is comparatively flat as at present, or is curved like the modern protective deck, or has a bomb-proof turtle back covering it entirely. Will the battleship of the future, then, be an immense cylindrical-backed hull, with one mast or none, innocent of funnels, leaving no trace of smoke behind her, and rushing at a speed of a railway train as she belches forth with almost unerring pre-

cision terrible explosives at a similar enemy so far distant as to be barely discernible on the horizon ? Are we to see cruisers as much faster than the battleship, as the present cruiser is than the present *Dreadnought ?* If, as is asserted to be possible, the battleship of twenty years hence will attain a speed of 30 knots under internal combustion engines, armed with weapons showing a corresponding advance in power and range and penetration, will the cruiser of that time cover its 40 or 45 knots, and the destroyer hurl itself forward at even greater speed to explode its torpedo, also correspondingly more destructive and deadly than now, at its foes ? Will the aeroplane enable the whereabouts of the submarine to be more easily detected than now ? It sounds like a confusion of ideas that such a thing should be suggested, but it is a well-established fact that it is possible to see further into the open sea from a height above it than when close to the surface. If the cruising aeroplane can detect and reveal the submarine to the battleship, the submarine will be robbed of half its terrors, and if the aeroplane can drop an explosive sufficiently near to the submarine it is not improbable that the career of the latter will be terminated instantly. The same fate may await the submarine as the result of the aeroplane signalling its whereabouts, for recent experiments have shown that it is possible for a warship to sink a submarine by gun-fire, even when the latter is several feet under the surface, the victim in this case being the ill-fated A1. Thus, it is not at all improbable that the under-water craft may find the swift aeroplane its greatest and most to be dreaded enemy. The aeroplane will be attacked by other aeroplanes, and aerial navies may yet be seen "grappling in the central blue," fighting their battles on their own account and so high among the clouds as to be almost out of reach of the guns which might be directed against them. Are

these ideas but visions and day dreams? It is impossible to say. Yet they have one and all been enunciated by naval experts and strategists. Whether these are the lines upon which the navy of the not distant future will operate, time alone will show. Events point in their direction. But one thing is assured, and that is that, marvellous as have been the developments in the last twenty-five years, it will indeed be strange if the developments of the next twenty-five years do not surpass them.

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